САМОЕ ЛУЧШЕЕ

August

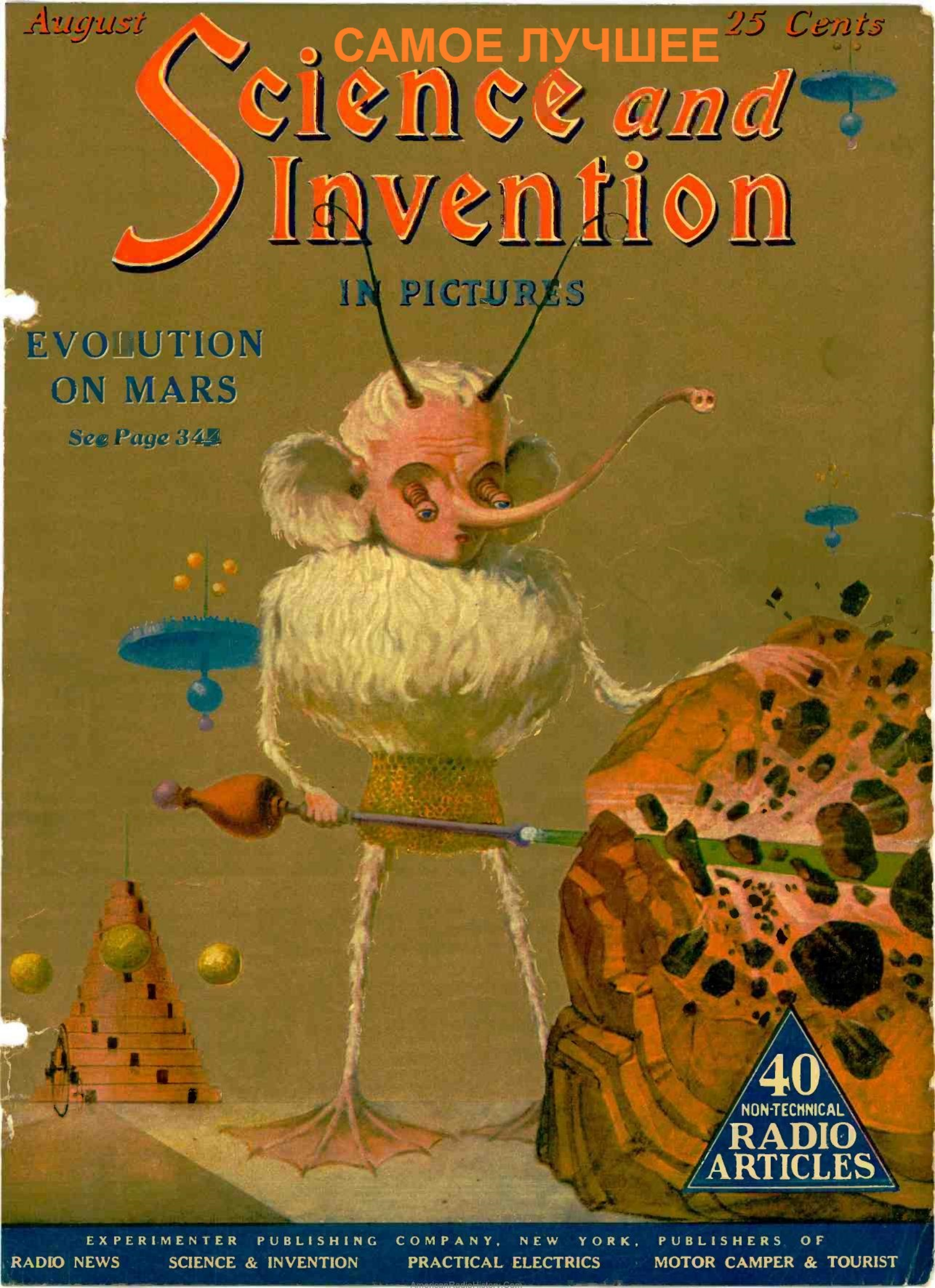
25 Cents

Science and Invention

IN PICTURES

EVOLUTION ON MARS

See Page 344



40 NON-TECHNICAL RADIO ARTICLES

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF

RADIO NEWS SCIENCE & INVENTION PRACTICAL ELECTRICS MOTOR CAMPER & TOURIST

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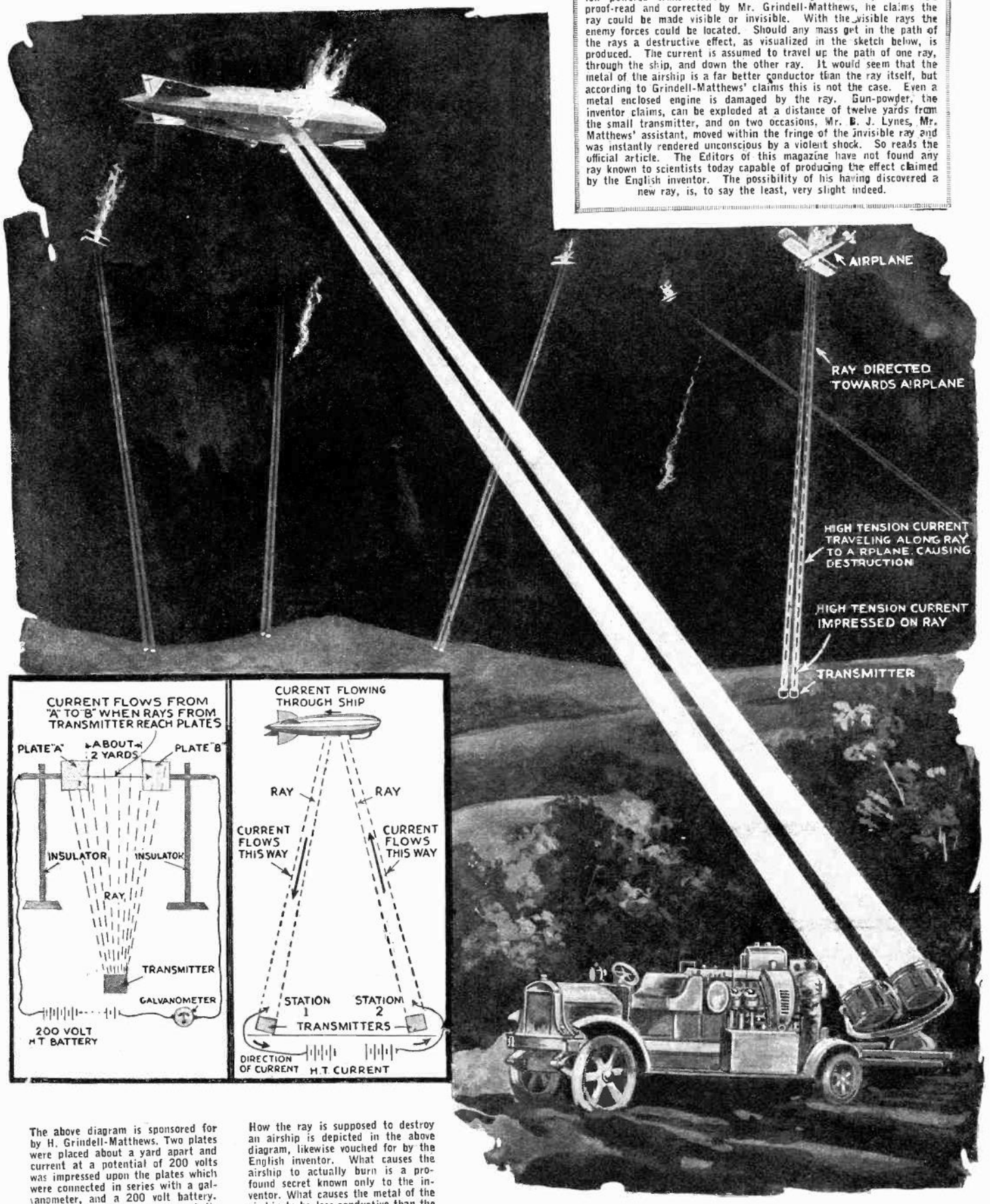
Is It Possible?

A FAMOUS inventor, H. Grindell-Matthews of London claims to have discovered a very dangerous ray. He states he used very low powered transmitters. In Mr. Oldroyd's article, which was proof-read and corrected by Mr. Grindell-Matthews, he claims the ray could be made visible or invisible. With the visible rays the enemy forces could be located. Should any mass get in the path of the rays a destructive effect, as visualized in the sketch below, is produced. The current is assumed to travel up the path of one ray, through the ship, and down the other ray. It would seem that the metal of the airship is a far better conductor than the ray itself, but according to Grindell-Matthews' claims this is not the case. Even a metal enclosed engine is damaged by the ray. Gun-powder, the inventor claims, can be exploded at a distance of twelve yards from the small transmitter, and on two occasions, Mr. B. J. Lynes, Mr. Matthews' assistant, moved within the fringe of the invisible ray and was instantly rendered unconscious by a violent shock. So reads the official article. The Editors of this magazine have not found any ray known to scientists today capable of producing the effect claimed by the English inventor. The possibility of his having discovered a new ray, is, to say the least, very slight indeed.



The above diagram is sponsored for by H. Grindell-Matthews. Two plates were placed about a yard apart and current at a potential of 200 volts was impressed upon the plates which were connected in series with a galvanometer, and a 200 volt battery. When the ray was turned on, as indicated in the diagram, the space between the two plates became conductive and the galvanometer registered the current flowing across the plates, according to Grindell-Matthews. He states the space across the plates was as conductive as though a wire actually connected them. We found the converse to be true with every ray.

How the ray is supposed to destroy an airship is depicted in the above diagram, likewise vouched for by the English inventor. What causes the airship to actually burn is a profound secret known only to the inventor. What causes the metal of the airship to be less conductive than the ray is not mentioned, and why the ray does not naturally become short-circuited cannot easily be seen. Our experiments definitely prove that these claims are fictitious. Radio, X-rays, ultra-violet and infra-red rays, the only useful rays that are invisible, cannot be made to duplicate Grindell-Matthews' claims.

The artist's conception of how the Grindell-Matthews' ray will bring down hostile airplanes and airships is depicted above. On the motor truck two powerful ray transmitters are mounted on swivels so that the beams of the transmitters may be directed on enemy aircraft. When the ray strikes, the airship burns. American and European scientists deny the reported discovery. Has Mr. Matthews discovered the impossible?

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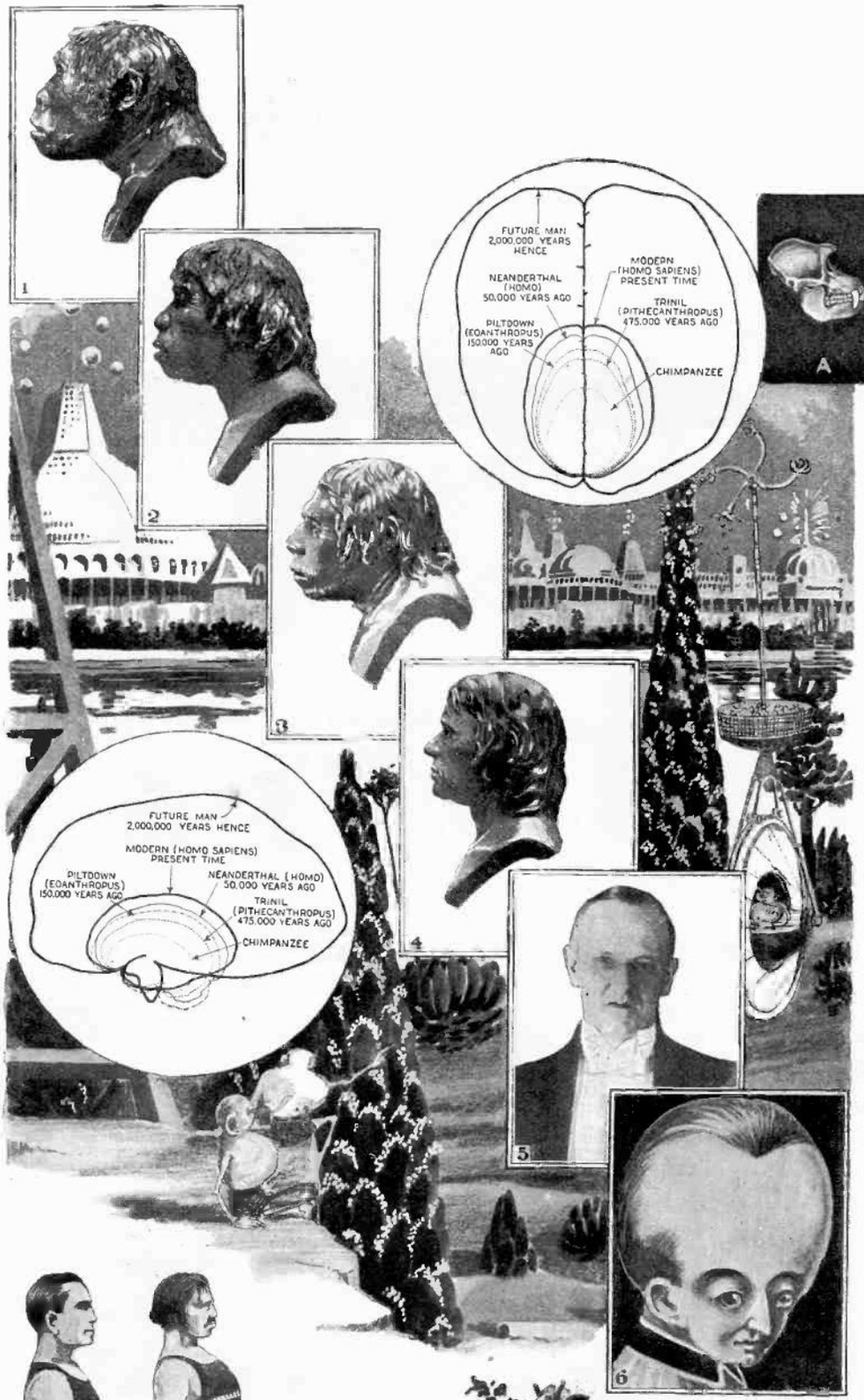
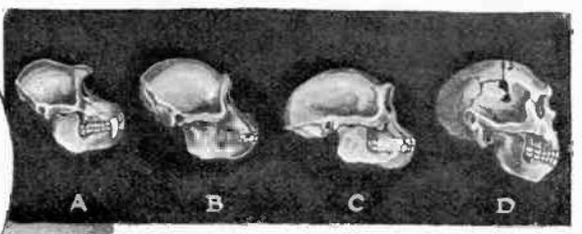
Evolution

By HUGO

MEMBER, AMERICAN





THIS month the opposition of Mars brings anew the speculation as to the inhabitants of the mysterious planet. Science to-day knows that Mars being a much smaller body than the earth, must have cooled down millions of years before the earth reached a similar stage. Scientists argue that this being the case evolution on Mars must in consequence be just as many million years advanced beyond our own.

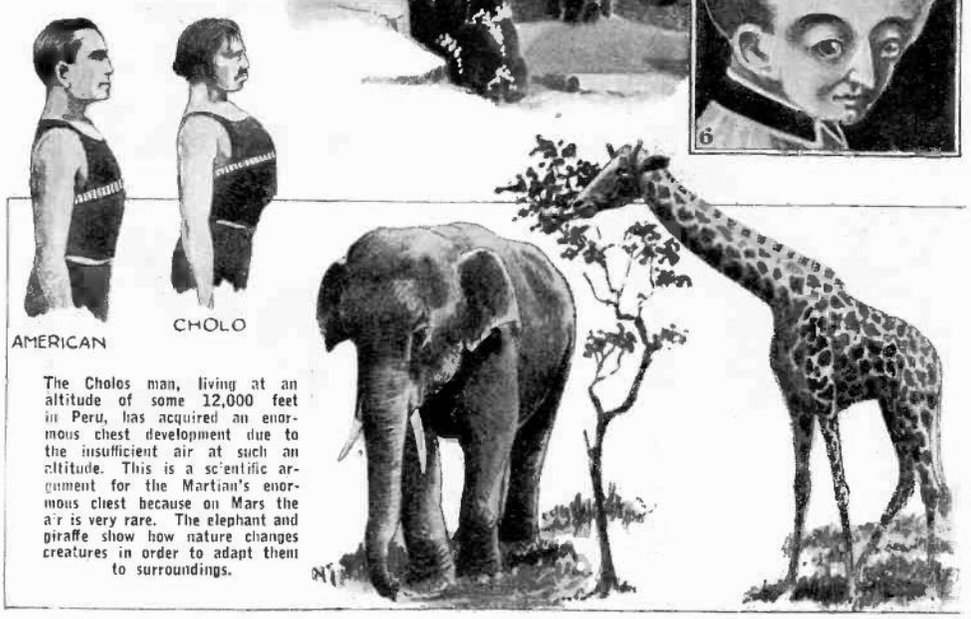
Granting that conditions are roughly alike on the two planets, evolution would in all probability work out as on our earth. If this were the case, of which of course we cannot be sure, it would be possible for us to form a general picture of what conditions are on Mars, but in order to understand evolution on Mars we must first understand evolution on earth.

The top strip on these pages lettered from "A" to "G" shows the evolution of our planet's most highly developed intelligent creatures. "A" shows the skull of a low form of monkey. "B" the skull of a chimpanzee. "C" the first real human being known as such to science and designated *pithecanthropus*. We now know that he lived some 475,000 years ago. "D" shows the skull of the *Neanderthal* race which lived some 150,000 years ago. "E" shows the skull of the *Aurignac* race which lived some 25,000 years ago and "F" shows the skull of the present day human being. What will be the appearance of the skull of man two million years hence? By studying our race which started almost a half million years ago, we see that the skull, that is that part which encloses the brain, has a tendency to become larger and larger. The figure "G" therefore will give a fairly accurate idea of what a human being will look like two million years hence.

This illustration has been carefully prepared from the diagramatic curves shown in the cross-sectional views of the skulls illustrated in the two round circles on this page. The upper one shows top sections of the brains of the various races while the lower circle shows the side views of the brains of the races. On this our artist has plotted the appearance of the brain two million years hence.

So much for the skulls, now for the actual appearance of the various human beings. Fig. 1 shows a reconstructed head of the Pithecanthropus, prehistoric man. Fig. 2 shows the restoration of the head of a Piltdown man. Fig. 3 shows the head of the Neanderthal man, while Fig. 4 shows the head of the Cro-Magnon man. Fig. 5 shows the modern man as represented by President Coolidge, while Fig. 6 shows the future man two million years hence.

Coming to Mars we know that some of the conditions of this planet differ somewhat from those on earth. Mars, to begin with, has practically no more atmosphere. It is certain that the planet once had the same kind of atmosphere as the earth.



The Cholos man, living at an altitude of some 12,000 feet in Peru, has acquired an enormous chest development due to the insufficient air at such an altitude. This is a scientific argument for the Martian's enormous chest because on Mars the air is very rare. The elephant and giraffe show how nature changes creatures in order to adapt them to surroundings.

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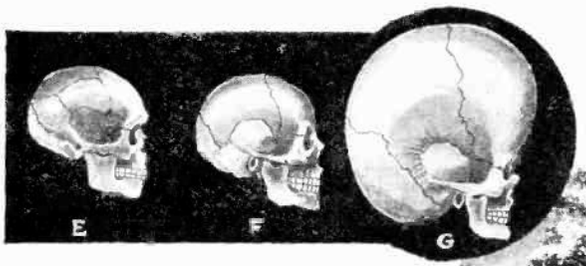
On Mars

GERNSBACK
PHYSICAL SOCIETY



This atmosphere, however, vanished little by little, until today about as little is left as is present on the top of the Himalayas. This means but one thing—due to lack of atmosphere and oxygen as well, the chest must become enlarged during the ages until it assumes extraordinary proportions. This is not at all a theory and has been proved on our own earth. There exists a race of Cholos Indians which race lives in the Peruvian mountains at an altitude of some 12,000 feet. Professor J. Barcroft, C.B.E., F.R.S., who made exhaustive studies of this race noted that the Cholos chest development had been increased from the normal or 79 c.m. to the abnormal 92 c.m. (see illustration in lower left hand corner page 342). On Mars which is also a much smaller planet the gravitational pull is much less, thus a man weighing 150 pounds on earth would weigh only 53 pounds on Mars. A human being can jump 4 feet, the Martian 11 feet with the same effort. A human being can lift 200 pounds while the Martian can lift 564 of the same earth pounds with the same effort.

Gravitational pull being so much smaller the Martian, if he exists, is probably very much taller than the human being, possibly from 15 to 20 feet tall. Having attained a far more advanced civilization, performing all work by machines and hardly ever attempting manual labor, the Martian's arms have shrunk until they are little more than bones with skin covering them. The body weighing much less on Mars and the Martian probably moving around only in mechanical contrivances, his legs have become almost useless and are therefore similarly attenuated. They also have but tiny muscles covered with skin. But in order to support such a tall body, (the gravitation being low), the Martian must have large feet.

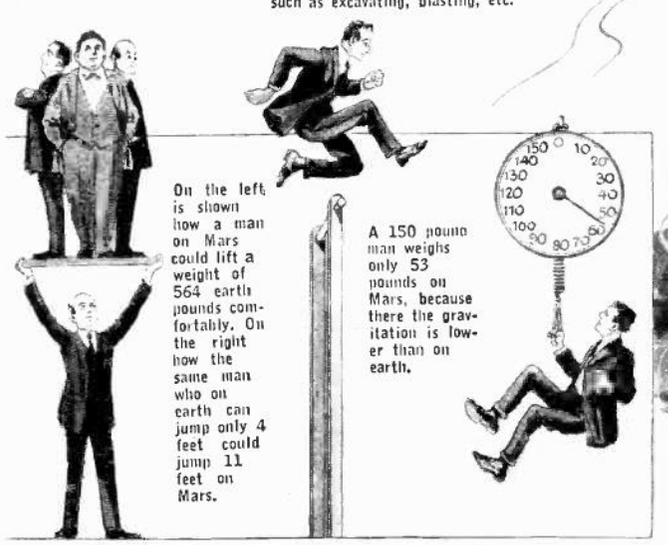
Now the scant Martian atmosphere makes it very difficult to smell. Scents are propagated very slowly in a scant atmosphere. For that reason the Martian must go to the smell rather than the smell come to him. We should therefore find an elephantine nose to compensate the Martian's shortcoming in this respect, just as the elephant had to grow a long trunk in order to make it easier for him to get to his water and just as the giraffe has a long neck to reach the food he likes.

In a thin atmosphere loud sounds become very weak. We should expect to find the Martian therefore equipped with large bat-like ears to catch more sound.

We may expect to find the Martian with projecting eyes if our deductions are correct and the temperature on Mars being nearly always freezing even at the Equator and going below zero at higher lattitude, the Martians will probably be covered with thick fur or feathers in order to keep him warm.

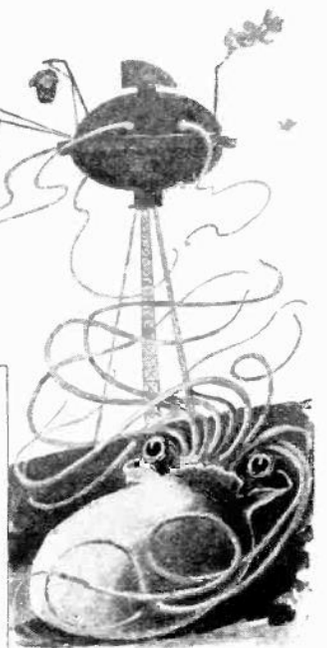
The two horn like projections on his forehead are antennae, and constitute the Martian's telepathic organ.

A fantastic, but scientific suggestion of the build of the Martian. Good logic suggests the large chest, the elephantine nose, the stork-like legs as explained in our article. The Martian uses an atomic or similar ray to perform work such as excavating, blasting, etc.



On the left is shown how a man on Mars could lift a weight of 564 earth pounds comfortably. On the right how the same man who on earth can jump only 4 feet could jump 11 feet on Mars.

A 150 pound man weighs only 53 pounds on Mars, because there the gravitation is lower than on earth.



H. G. Wells' conception of a Martian. This Martian is composed of nothing but brains, legs and tentacles. In order to move about he uses a tripod "walking" machine which is shown above him.

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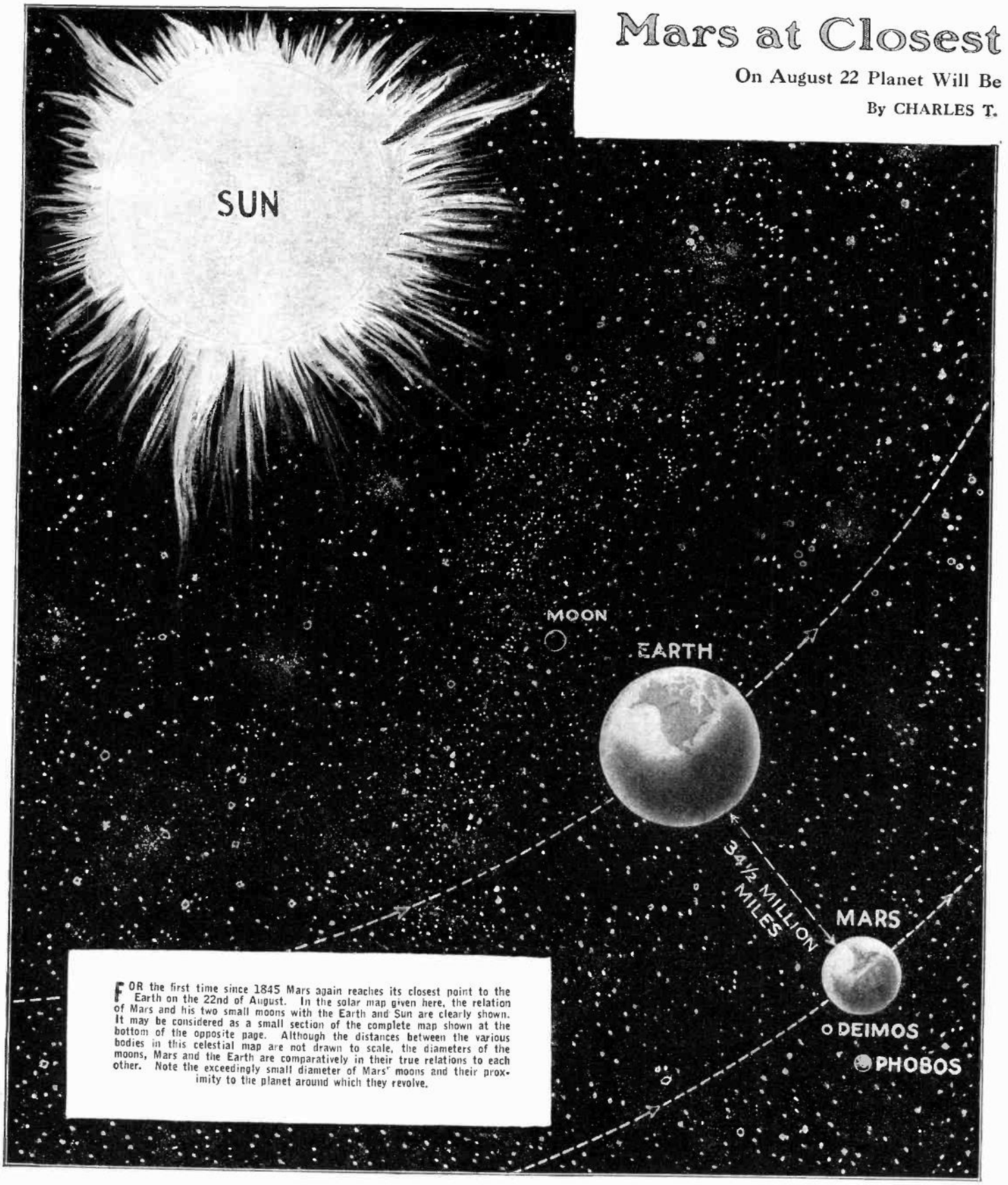
Mars at Closest

On August 22 Planet Will Be

By CHARLES T.



FOR the first time since 1845 Mars again reaches its closest point to the Earth on the 22nd of August. In the solar map given here, the relation of Mars and his two small moons with the Earth and Sun are clearly shown. It may be considered as a small section of the complete map shown at the bottom of the opposite page. Although the distances between the various bodies in this celestial map are not drawn to scale, the diameters of the moons, Mars and the Earth are comparatively in their true relations to each other. Note the exceedingly small diameter of Mars' moons and their proximity to the planet around which they revolve.

WITH the exception of the moon, astronomers know more of Mars than of any other celestial body. The planet Venus approaches nearer the earth, but is usually surrounded by clouds defeating observations. The rarity of the atmosphere on Mars, however (even less dense than that atop Mt. Everest), allows excellent observations. As seen through a telescope, his surface resembles red sandstone. The polar caps, surely of snow, are white while tinges of green in certain spots indicate the existence of vegetation. This point, however, is disputed since the rarity of the atmosphere would make it impossible for vegetable life as we know it to exist on the planet. With so little air, the sky of Mars would not have the blue tint familiar to the earth. Even at noon the sky would be almost jet black. Stars would be visible by day. As seen from Mars the Earth would be a spectacle of beauty, about as bright as Venus is to us, with the added attraction of the moon, which would appear with practically the same luminosity as Sirius.

Clouds about the earth's surface might dim her glory upon occasion, however.

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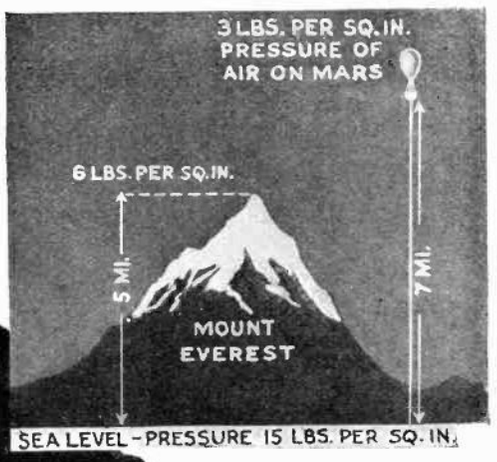
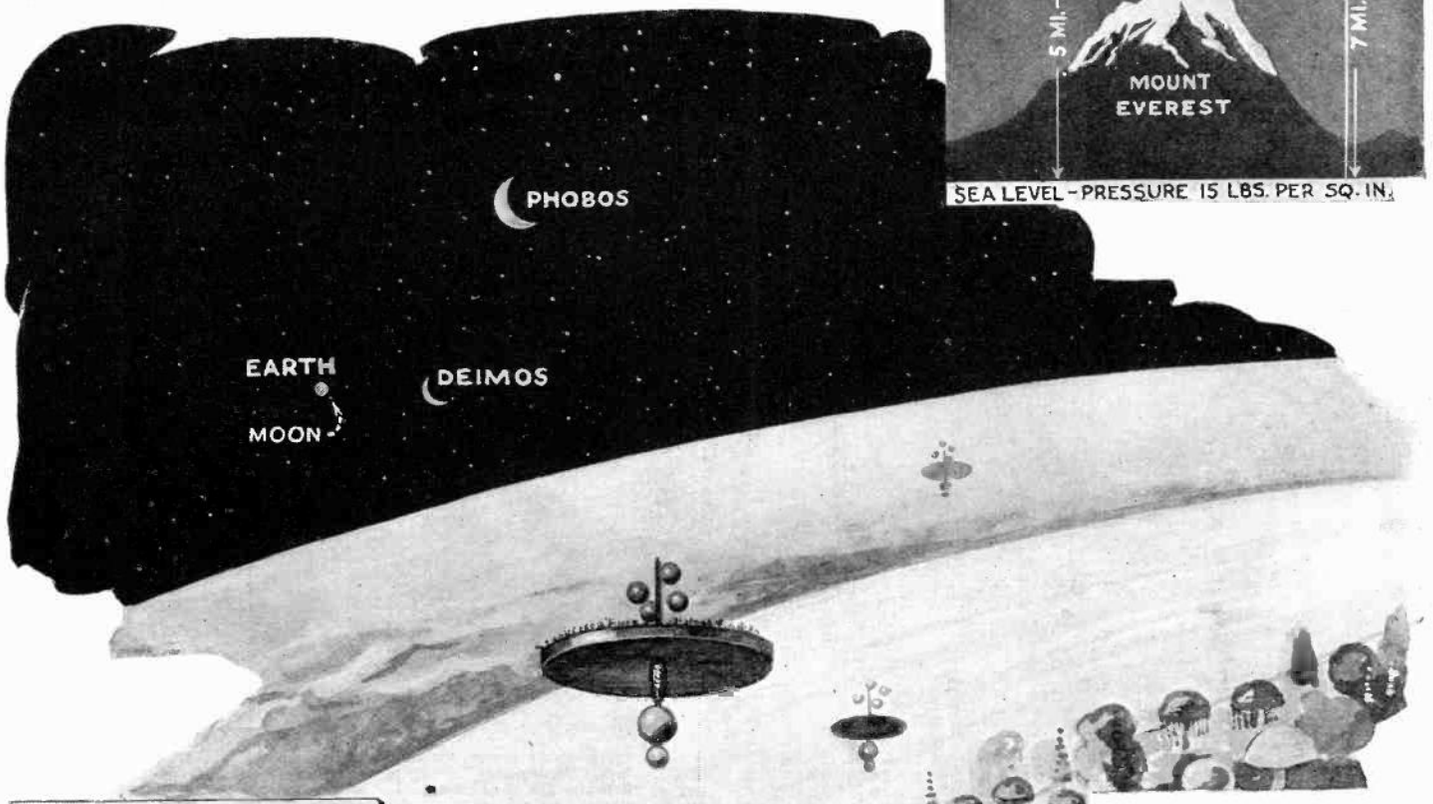
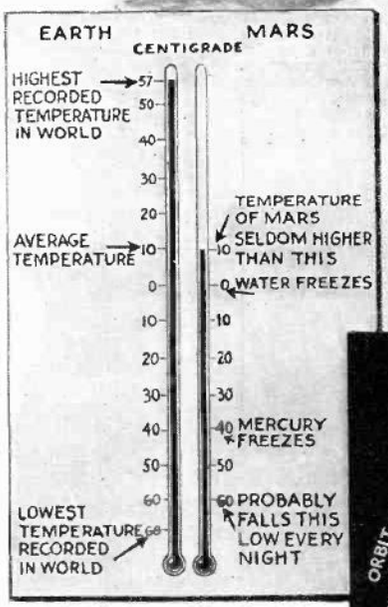
Point to Earth

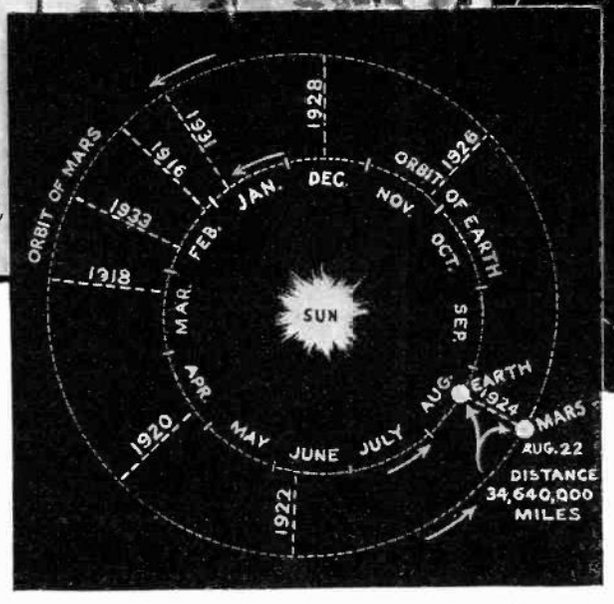
Only 34 Million Miles Away.

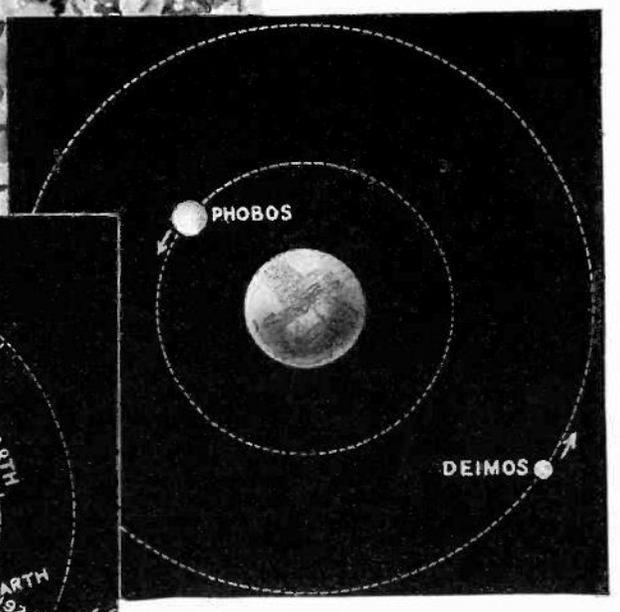
DAHAMA, Ph. D.











The large center illustration gives a scientific deduction of the appearance of a Mars' landscape. The two moons of the planet, as well as the Earth and moon, are shown in the sky. In the foreground is one of the hypothetical Martian canals, along the edge of which there is queer vegetation, while above floats Mr. Gernsback's conception of a Martian aerial flyer. Mars has two moons, discovered in 1877 by Prof. Hall of the U. S. Naval Observatory. The nearer one, Phobos, is only about 3,700 miles above Mars' surface, and it performs a single revolution in seven hours thirty-nine minutes, less than one-third the Martian day.

At the extreme top of the page is shown a comparison by which the reader may judge the density of the Martian atmosphere. Were a balloonist to ascend seven miles above the earth, he would reach the approximate density which obtains at the surface of Mars. The thermometers at the left show graphically the range of temperatures through which the surface air on the red planet passes every day. The map at the immediate left shows the two orbits of the Earth and Mars, while the sketch above gives an idea of the relation between the planet and his two moons.

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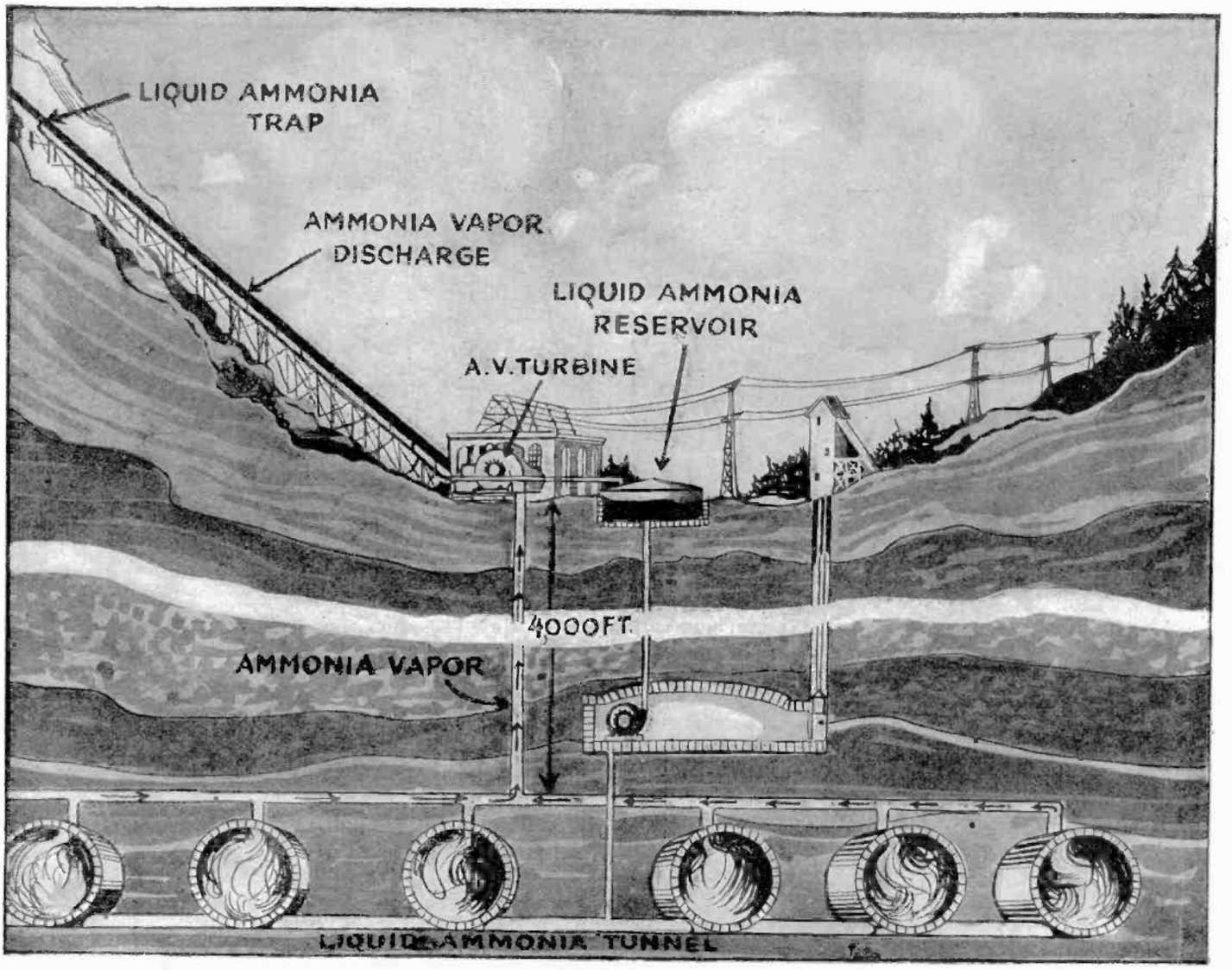
Power From Earth's Heat

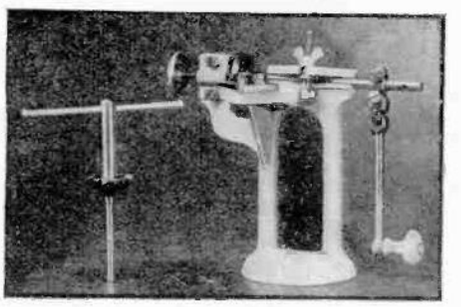


This is a more or less novel scheme for utilizing the interior heat of the earth for producing power. As shown in the illustration above large hollow tanks are placed at a depth of 4,000 feet beneath the earth's surface, where the temperature remains constantly about 96° F. Ammonia is fed down to these tanks through a liquid pump. The heat of the earth immediately vaporizes the ammonia, and the vapor passes up through a communicating pipe to an ammonia vapor turbine at the earth's surface. The vapor exhausts to the decreased temperature of a mountain top, where it liquefies and returns to the reservoir to be used again. —Albert Pedazus.

Earth and Moon Compared

At the left the two pictures give a very clear idea of the relation of the sizes of the earth and its satellite. The first one shows how the moon appears to us on earth. The other picture gives a very clear idea to scale of the earth's appearance to an observer on the moon. Note the clarity of definition of earth land areas.

Valve Grinder



The reseating of automobile engine valves is greatly facilitated through the use of the little machine illustrated above at left. The valve refacer at right is built on the idea of a lathe. The handle attaches to the valve shaft which rests in a special cradle accurately centered. The angle of the cutting tool is adjustable.—Allen P. Child.

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The Electrical Experimenter

AN ELECTRO - GYRO - CRUISER

SEE PAGE 542

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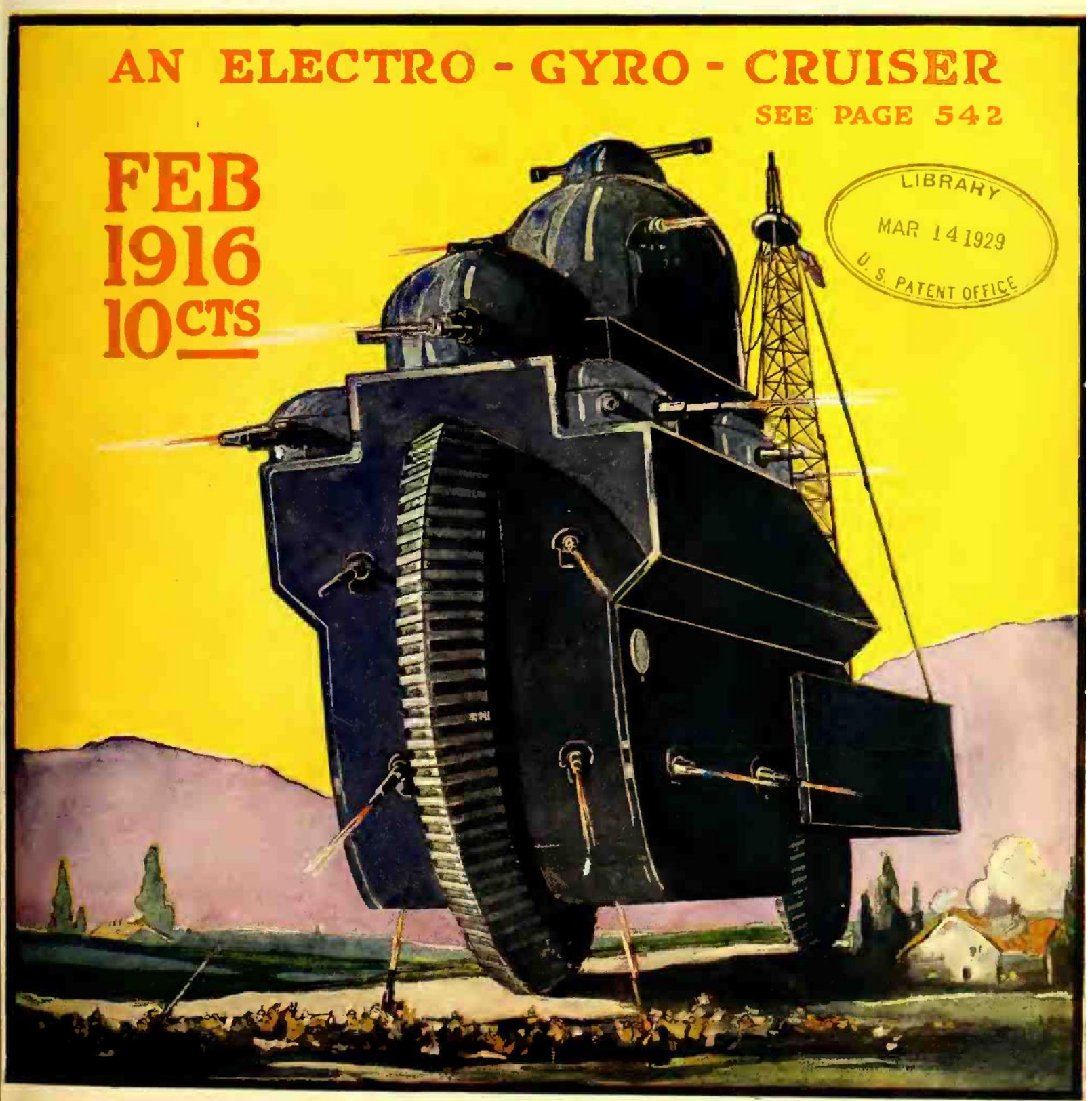

"THE ELECTRICAL MAGAZINE FOR EVERYBODY"

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New Searchlights Foil the Enemy's Guns

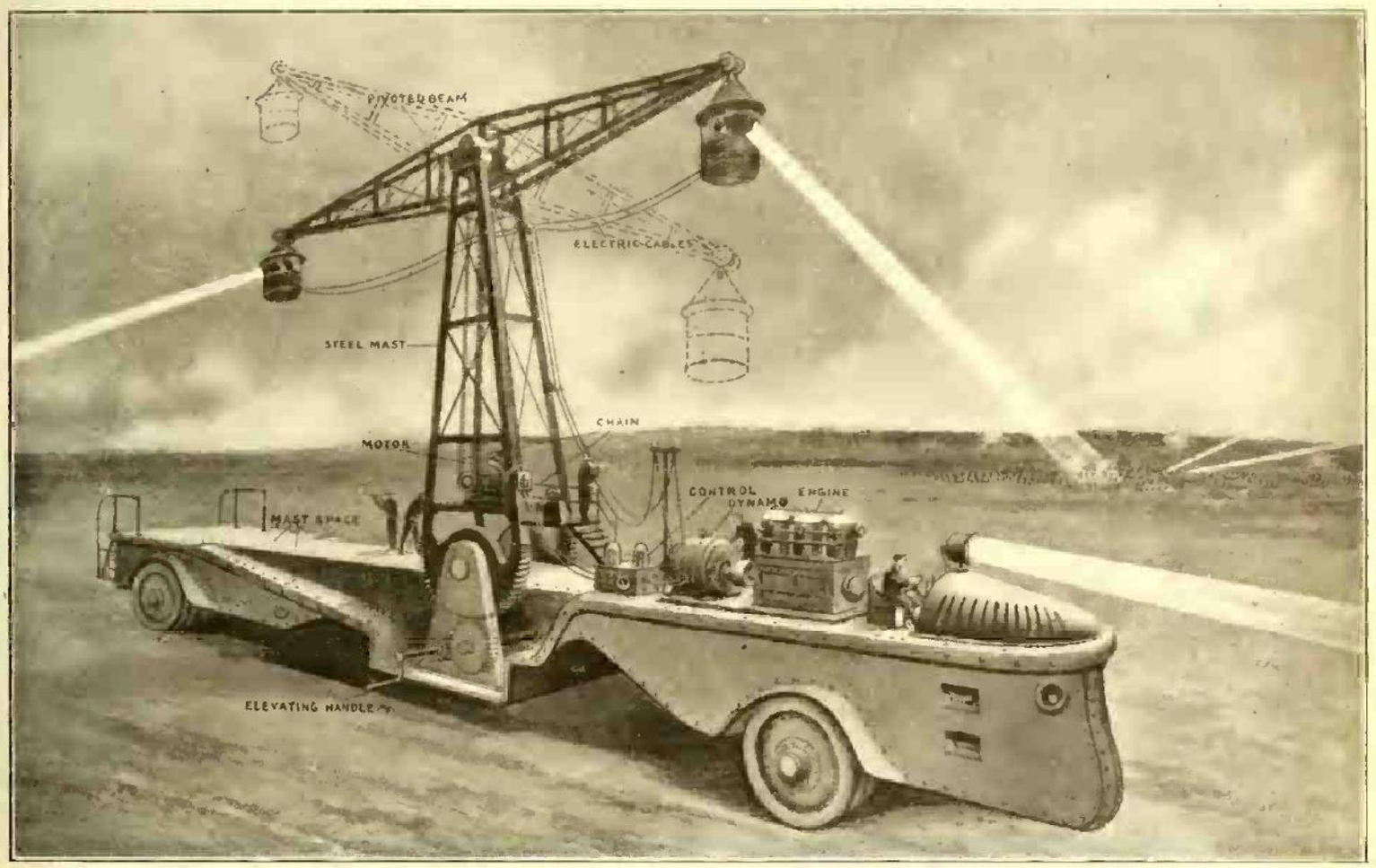
IN the illustration herewith is perceived a somewhat novel form of searchlight mounted on a rapidly movable or oscillating arm, which in turn is carried by a powerful motor truck so as to be very mobile and thus readily transported from place to place as required. This idea has been brought forth by H. Gernsback.

As is quite well known, a fixed searchlight, such as now used by the great European armies, becomes very quickly a target for missiles of all sizes and descriptions, which, needless to say, soon reduce it to a scrap heap. The gun spotters of today, even those in charge of large caliber field pieces, are notoriously accurate in their work, and unless a searchlight which is visible to them is constantly moved it is bound to be the unhappy target for a host of high explosive shells before many peaceful moments have passed.

To obviate these and other untoward difficulties surrounding the use of searchlights in night-time warfare, this design has been promulgated, and, as may be gleaned from the illustration, it is intended to use one or both searchlight beams at the same time. The motor truck of large size carries a complete dynamo and gasoline engine for running same, which is seen mounted behind the driver's seat on the truck. By means of heavy flexible cables from the dynamo the searchlights, which are carried in small cases when not in use, are supplied with current. When being used the projectors are constantly oscillated or moved up and down at an ever-changing speed. This is obtained by a hand crank, which is shown in the illustration.

However, it is possible to also effect this irregular up and down movement of the horizontal girder carrying the searchlight baskets by means of electricity. The electric control box for this arrangement is indicated on the truck. Such a mechanism may consist principally of a motor-driven drum having on its surface a considerable number of segments making contact with a pair of brushes. To every pair of segments on the drum there can be joined a different resistance, so that as the drum is rotated it will cause differing values of current to be supplied to the motor on the main pedestal, which in turn controls the up and down movement of the horizontal searchlight girder.

It is also very easy to arrange reverse current trips on the device just mentioned, so that the arm will move downward so many degrees and then reverse and move upward so many degrees. If desired, this arrangement may be modified in many ways so as to be adapted to stationary requirements. In such an event the truck could be made many times larger, most probably to advantage. Again, the center pedestal carrying the constantly moving horizontal arm could be swung about on its vertical axis so as to give greater play to the searchlights and also simultaneously to make them a more difficult target for the enemy's gunners. The dotted lines in the illustration show a second position of the horizontal girder carrying the searchlight baskets. It is thought that the constantly moving searchlights of this type are practically proof against the enemy's fire, as it would be impossible to accurately train a gun on them. However, it remains for such a device to be actually tried out before we can predict the results.



Remarkable Mobile Searchlight Tractor Designed to Keep the Searchlights Constantly Moving, Vertically as Well as Horizontally. A Difficult Target for the Enemy.

PROFESSOR ULIVI OUTDONE IN AMERICA?

Professor Montraville M. Wood, of Chicago, who spoke in Paul Revere Hall at Boston, recently, outdid Giulio Ulivi's claims for his F-rays in claims for the ultra-violet rays, which appear to be the same thing. According, however, to Professor Wood, the naval advisory board is in possession of "the secret of the ultra-violet ray" and the wonderful power it controls, and is conducting experiments with it, and he predicts that within a short time the turret guns of the ships of the United States will be operated automatically by the use of the ultra-violet ray, and that the guns will not fire until they are in a direct line with the object at which they are aimed. Men, except to load the guns, will not be needed.

In regard to the employment of time fuses in the starting of fires on board the ships carrying supplies, the professor says, what really happens is that someone, either off shore or on the ship, conceals a carefully tuned Hertzian ring in a lump of coal, and closes the cup, or gap, with a piece of guncotton. The ship sails, gets as far as mid-ocean. There is a sudden explosion, followed by fire. An operator on shore fired that ship, either by tuning his wireless coil until he reached the proper wave, or by bringing the ring in focus with the ultra-violet ray, or so the professor thinks.

DETECTS THUNDER STORMS 300 MILES AWAY.

Using a modified wireless receiving instrument, a French scientist has been able to detect thunder storms more than 300 miles distant.

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The Trench Tractor

By H. Gernsback

BEFORE the advent of the monstrous 14-inch field guns, it was thought impossible to take a well-manned fortress by the then existing means. But since we have learned that the strongest fortress can be reduced within a few hours to a mere scrap heap it has become necessary to keep the enemy so far away from the fortress that his guns cannot reach it.

So the curious paradox has come to pass, as witnessed in the great war, that concrete and steel fortresses are protected no longer by stone or steel walls, but by human flesh sheltered by trenches.

Once two contending armies dig themselves in trenches, these armies practically cease to exist for their respective countries. They become deadlocked and up to this time, as the European war demonstrates so clearly, nothing has been invented whereby one army can effectively drive the other from their trenches. For over eighteen months at this time of writing the Germans and the French have been deadlocked, neither contending army having moved forward or backward for more than five miles. To be sure, local successes occur here and there and sometimes one or the other carries a few hundred yards of trenches only to lose them the next day.

The Germans being the first to realize the unsatisfactory results of trench warfare set out to devise some means to drive the enemy from his trenches. We are all familiar with the result whereby poisonous or asphyxiating gases were used. This plan worked well for a time till the enemy learned to wear respirators, and it is now a rare occurrence that a trench is won by means of gases alone.

What is needed to-day is a machine to effectually combat the men in the trenches by either destroying them or otherwise putting them out of action. This must be accomplished with great rapidity in order to quickly repeat the operations with the second and the third line of trenches. Then when a successful gap has been made, it will be a comparatively simple matter for the men to rush up into the break and "*consolidate*" the new advanced positions, as the French term this process.

The writer desires to advance a new idea by which to accomplish the foregoing, and while it may appear fantastic at first thought it is nevertheless not an impossibility. We need but remind the incredulous that but eighteen months ago the wisest military engineers outside of Germany would have laughed at the idea of running a 14-inch 140 ton gun over land. It was accomplished, nevertheless.

While the Trench Tractor as conceived by the writer is of course purely imaginary, we are not at all sure that a machine of this type will not roll over the ground in the not very distant future.

Briefly, the Trench Tractor is a huge two-wheeled monster, propelled by electricity and of sufficient size to "walk" over ordinary trenches with ease.

The imaginary tractor, as shown in our illustration, has two wheels, each 40 feet high and 15 feet wide. The business part of the machine is about 70 feet long and about 15 feet square. In it are carried 200 fully armed men, bomb throwers, a number of 3-inch and 6-inch guns, as well as machine guns, ammunition stores, supplies, wireless apparatus, a steam generating plant, the two power plants, etc., etc. The tractor is to run at a speed of about 20 miles and is estimated to weigh 10,000 tons. It is needless to say that the body of the machine is armored with a heavy plating so as to protect the men in the interior from the enemy's shell fire.

At first thought one would imagine that such a huge machine requires an enormous amount of power to move it at a speed of 20 miles an hour, but this is not the case. Moving over level ground but 2,600 horsepower are required, which is but 2,000 kw. The average electric train of 3,000 tons requires 605 kw. to move it at 20 miles an hour.

Thus our imaginary tractor, to run over rough ground or to ascend hills (in a zigzag line) would not require over 3,500 horsepower at the utmost. This is very much less than is used by a moderate-sized steamship.

The right wheel, which shows the detail of the motor which propels the former, is illustrated with the plating broken away to show the interior; both wheels, however, are of course heavily plated with armor to protect the motors.

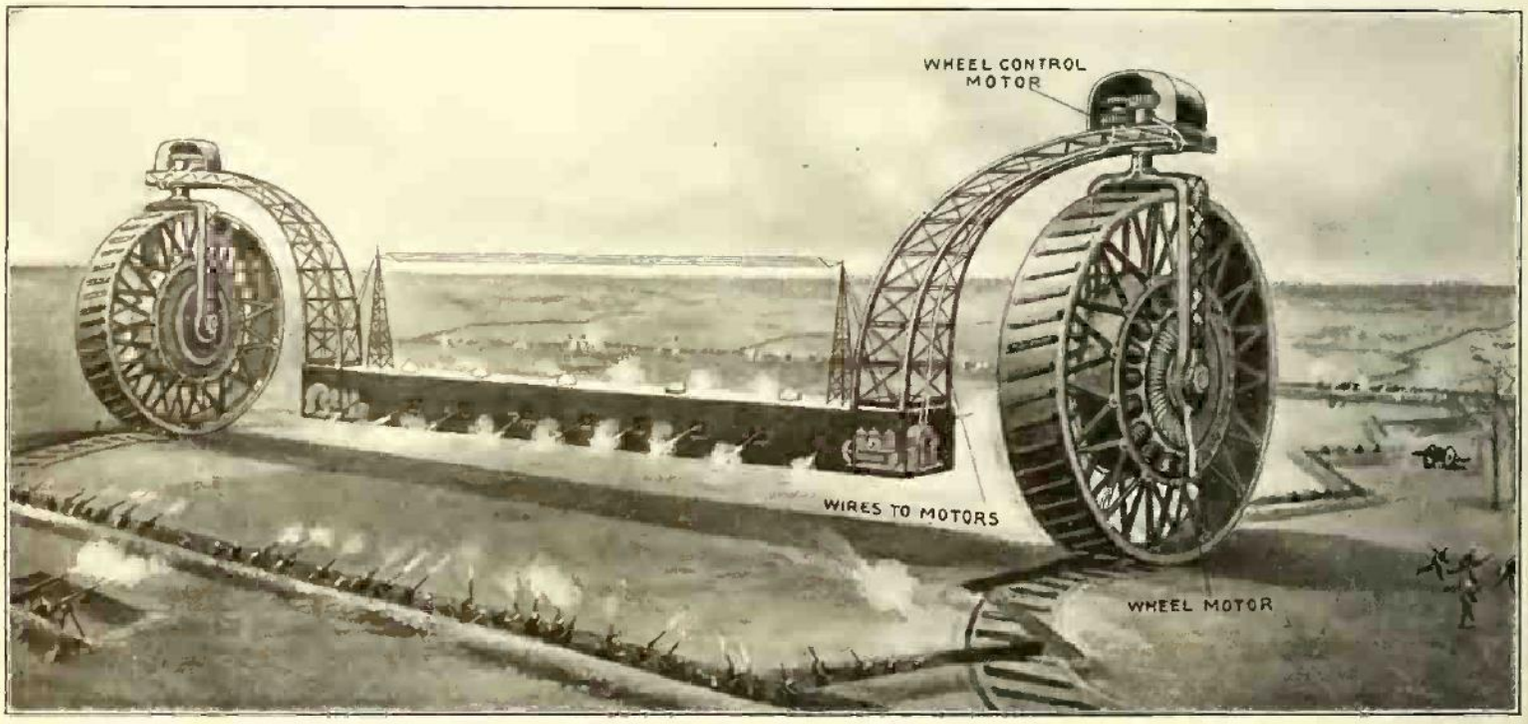
Two independent high speed gasoline or oil engines are used to drive the dynamos, which in turn supply the current to the slow running wheel motors. As the wheels are so large they need but run at 14 revolutions per minute in order to drive the tractor at a speed of 20 miles per hour. For this, and other self-apparent reasons, the electric mode of propelling the machine is necessary.

In the illustration the tractor is shown running with its wheels parallel to each other. This is the fighting position. As the length of the entire machine, measured from one side of one wheel to the other is over 140 feet, the tractor could not of course run on a road. For this and other reasons the wheels can be turned about, bicycle fashion, so that the machine can run lengthwise. In this position it measures but 18 feet wide and it will roll comfortably on a road and even over a steel bridge. In this position also it offers but small surface to the enemy's fire.

The body of the tractor swings about 10 feet above the ground, and as our illustration shows the machine has just run over the enemy's first trench. It therefore *attacks him in the rear*. In a few minutes the men from the tractor's regiment trenches will rush up and the enemy *will be under fire from two sides*. The enemy is overpowered while the tractor rolls over the second trench and repeats the operation there, and so on if other trenches are left. A less bloody variation of this may be had when the tractor stops right above the enemy's trench. By means of its steam plant live steam in great quantities may be let loose on the men in the trench below, and this method presents several advantages.

First, it is a very powerful argument to

(*Continued on page* 587.)



A Powerful Land Fighting Machine That Can Travel Sidewise or Longitudinally. It is Capable of Carrying Heavy Guns as Well as Rapid Fire Machine Guns.

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The Electric Gyro-Cruiser

A Rolling Electric Gyroscope Fort of the Near Future. By Eric R. Lyon, A. B.

THE world will have wars for generations yet to come, but the time is near at hand when their destruction of human life must cease. How is this to be? Simply that all future war must be naval warfare, by which we mean there must be a navy for each of the three elements, earth, air and sea. We have our navy on the sea, and we have begun our navy of the air. Who knows but that our last and greatest navy stands now upon the threshold of human ideas, awaiting only a proper invitation for its entrance into our affairs?

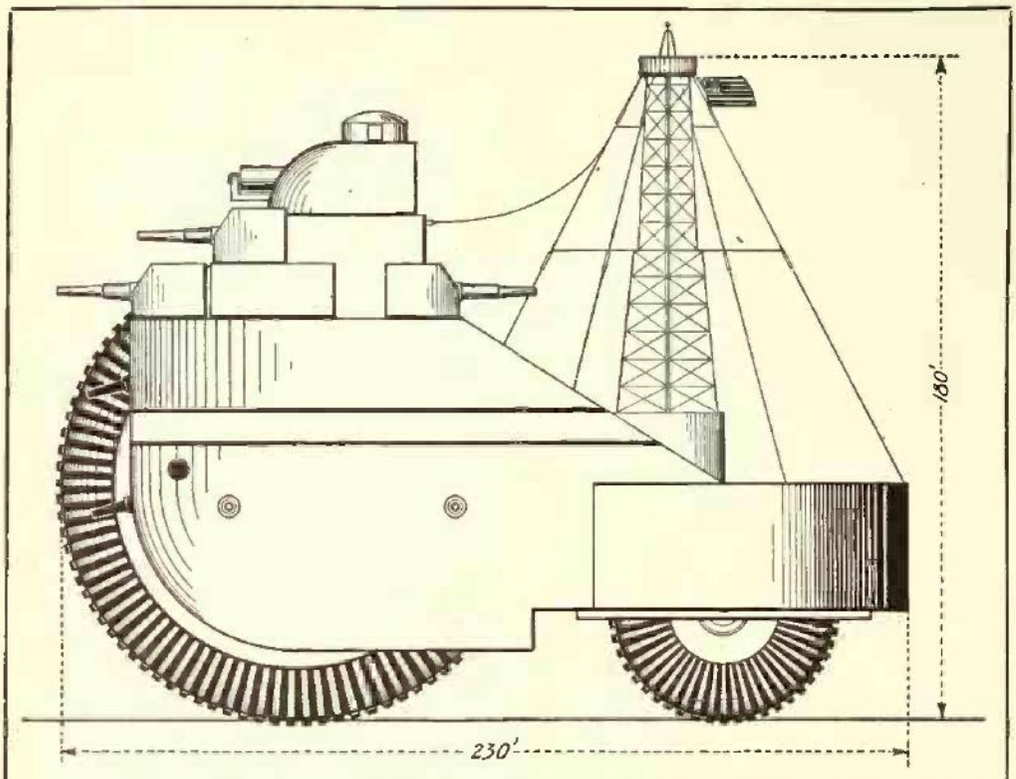

Fig. 1. Side View of Possible Land Cruiser of the Near Future. It Could Smash Any Fort With Its 42-Cm. Guns.

Suppose Great Britain's giant navy could now come up out of the sea into the plains of northern France and, mounting itself upon wheels, dash in single line formation at express train speed upon one single, unsuspecting and strategic point of Germany's hundreds of miles of battle front. What would happen?

We are told that "this is a war of ammunition;" that the decision of this war is practically a question as to which side can ultimately hurl the most tons of shot and shell into the trenches of his opponents. Now we know that if you and I and Smith and Jones and all of our neighbors are strung out over a hundred miles of battle front it is going to take an enormous amount of shelling to shell us out. But if the enemy should suddenly concentrate all of his fire upon Jones' pasture, or even upon 15 miles of battle front adjoining the pasture, there is not going to be one man left alive in all of that harnel ground to prevent the enemy breaking through. This, in brief, is the tactics of the present war. The enemy does break through. His infantry runs, his cavalry gallops and his big guns creep; all trying to get through the gap in our lines. In the meantime the warning has gone out broadcast to all of us. We rush in our reserves, and move up our own big guns to defend the breach. We storm the field. We mow down his necessarily massed ranks as with a reaping machine. We convert that 15 mile breach into a veritable inferno of hail, wind and destruction; or steel, fire and blood. The enemy is forced to retire; that is, all of him left to retire. We close up the breach, dig in again and await the next assault. This also is the tactics of the present war. Our infantry can move as rapidly as the enemy's infantry; our cavalry can gallop as hard as his cavalry, and our big guns can creep as slowly as his big guns. Consequently we were there in force before he could break through far enough to do him good. The net result of the whole encounter is another blood sacrifice to the war demon, and another call for ammunition on both sides.

Transferring ourselves from Jones' pasture to a point overlooking that select portion of the German battle front which we before mention J, we may now imagine what begins to happen as the great British fleet comes in range behind the distant horizon. Our first warning of the impending battle is the increasing rattle of machine guns in the clouds, as the few local scouts of the German aerial fleet flee before the concentrated and overwhelming British aerial navy. Presently down comes a German Taube in flames. The British planes are circling far overhead and are signaling the ranges to the British gunners behind the horizon. The staccato roar of the German anti-aircraft guns has begun There is a distant rumble. The one remaining door of the hut in which we have taken refuge shudders, and immediately 10 or 20 bursts of flame search out the German batteries. In range of this 15 or 20 mile strip the Germans have 11 big howitzers. These are the chief concern of the British gunners. The British aerial fleet signals back the results. In the meantime one Taube scout has succeeded in landing behind the German lines. Ranges and movement of the British land fleet are immediately 'phoned to the German gunners. The big howitzers open fire, but the British aerial fleet, pursuing the Taube scout, had signaled warning to their land fleet when they could not prevent the scout's landing; and so, when the German 42-centimeter shells tear up a certain plot of ground behind the horizon it is from another point behind that ominous line that the first great answering salvo thunders forth. Through the glass we observe a distant German battery go up in flame and twisted steel. The thunderings become incessant and they seem to be coming nearer. Their salvos must be finding the targets. Suddenly the field has become alive with the bursts of six-inch shells seeking out the Germans' lesser batteries. Panic reigns. Through our glass we can see men and cannons dashing madly to new positions away from the bursts of those deadly pursuing shells. Yet not a man can we see going to the rear. The Germans have even in their despair resolved to stand their ground and die before the overwhelming onslaught. But neither do the British shells fall among the massed German infantry reserves, nor in the trenches armed only with machine guns and men helpless in the vortex of

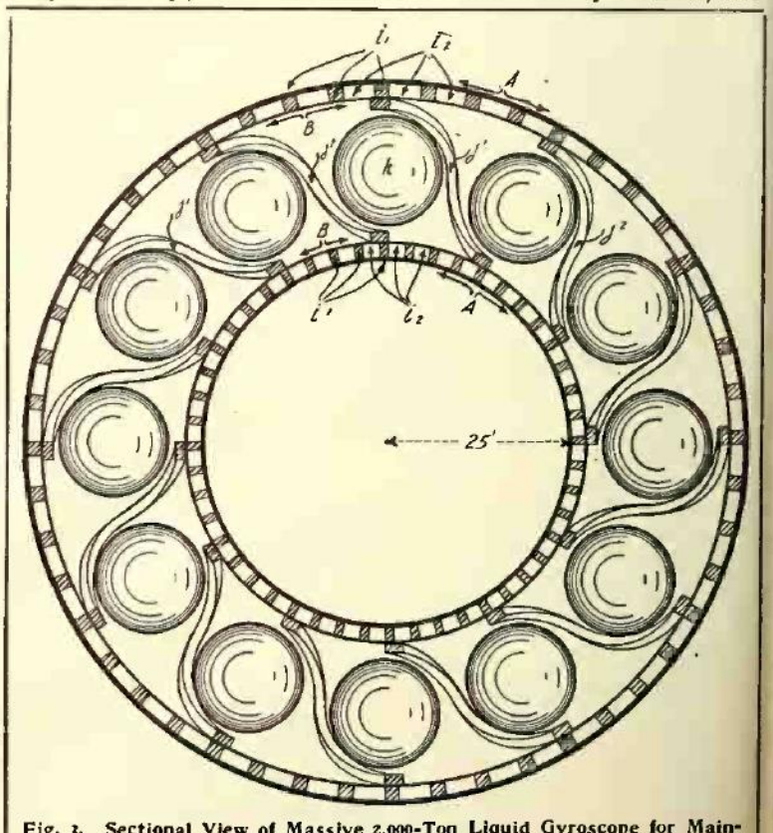

Fig. 3. Sectional View of Massive 2,000-Ton Liquid Gyroscope for Maintaining Equilibrium of Land Cruiser.

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this maelstrom, for Britain has not elected to slaughter her enemies, but to overcome and to disarm them.

At last the hail of shell has ceased in the district under our observation and has swept out like a scythe into the far outlying districts. The breach has been made. The British monsters appear upon the horizon thundering, flaming, racing; bearing down upon us at express train speed. Onward they come. Presently one sweeps past into the gap and then another and another.

The memorable raid of the British land fleet had begun. It is recorded—and so it will be when the imagined incident here pictured shall have become a matter of past history—it is recorded that the British land fleet, having broken through the German lines, cut a swath of destruction through to Berlin more effective than even the famous Sherman's march through Georgia, and as they rode they destroyed every means of communication, of transportation; every munitions depot and provision depot; and ending with the destruction of the great Krupp works, there followed the surrender within a few weeks of the whole German army for lack of provisions and munitions. A new epoch was begun.

This is the picture of the possibilities of the new arm of military power. Now let us consider the probable form of its machinery. The form which first suggests itself is, most naturally, an overgrown reproduction of the common four-wheeled truck or wagon, and if such a device were designed to operate only over level ground or over especially prepared roads of about 100 feet in breadth it would be capable of good service and great speed. It would be possible to construct such roads all along the coastal country to be defended, and yet the four-wheeled units would be sadly hampered by their inability to operate away from the ideal conditions so prepared. If a unit of the future land navy, or a land cruiser we may call it, is to be of real service it must be able to maneuver anywhere over any kind of ground except precipices, and it must be able to make express train speed over common country roads and over the fields of gently rolling country. A device of this type is possible only when it shall employ some other means than a broad wheel base to maintain itself upright. Indeed, if the land cruiser is to be operated over country roads the breadth of its wheel base cannot exceed the breadth of the road, some 25 or 50 feet, which fact would necessitate balancing the structure upon not more than two great wheels—bicycle fashion. Going at full speed our huge device would be able to balance itself after the manner of a bicyclist, but it must also be able to maintain itself firm and upright even when standing still. To accomplish this there is one practical means of which we are aware, and that is the gyroscope.

Let us then call our land cruiser a gyro-cruiser. A likeness of what this may be we have in Fig. 1. Gyro-cruisers will begin, of course, very humbly, and at first will be gyro-trucks rather than gyro-cruisers. The conditions of mounting the gyroscope in the gyro-truck; the conditions of mounting the weight of the structure upon its wheels and, in fact, almost all of the conditions governing the small device will be different from those which will be found for the huge machine. So it is not with the steps upon the way, but with the type of the full-grown cruiser, of the gyro-navy in its prime, with which we are now concerned. Such, we may imagine, is the American gyro-cruiser shown in Fig. 1, with its extreme height of 180 feet from ground to top of fire control mast, its extreme length of 230 feet, its maximum breadth or beam of 87 feet and its maximum wheel breadth of 25 feet. The weight will be about 20,000 tons, one-tenth of which, 2,000 tons, will be the weight of the liquid gyroscope carried in the rim of the great wheel. The latter may be seen projecting downward and forward of the main substructure in the diagram, Fig. 1. The gyro-cruiser will mount 12 17-inch guns (or will they by that time have grown to 27 inches?) in six turrets, three of which are shown, the other three being similarly placed on the other side of the superstructure, and will be able to fire a salvo of eight guns in nearly every direction from the cruiser. Instead of the customary arrangement of low caliber guns, as in a battleship, an arrangement which is made necessary by the manner of firing with respect to the roll of the ship, the gyro-cruiser will mount in the 40-foot crown turret shown a huge machine gun, comprised of a rotating cylinder having mounted in it a sufficient number of complete and individually recoiling six-inch rifles, which shall be electrically fired as they successively pass through a predetermined firing position. One man will be able to aim and control the fire of a torrent of six-inch shells, and thus a weapon will be provided which, being peculiarly adapted to the gyro-cruiser, will give the latter added superiority to any other type of military unit operating upon the land. The great wheel shown in Fig. 1 is the traction wheel, and it is 108 feet in diameter from one beveled, cutting-edge foot to the other. The "little" wheel, which is 60 feet in diameter, is the steering wheel, and is also the balancing wheel—a fact which is apparent when we consider that in order for a gyroscope rotating in a vertical plane to exert its balancing power about a horizontal axis, it must be able to swing freely about a vertical axis. The uses of the aerial and fire control mast are obvious.

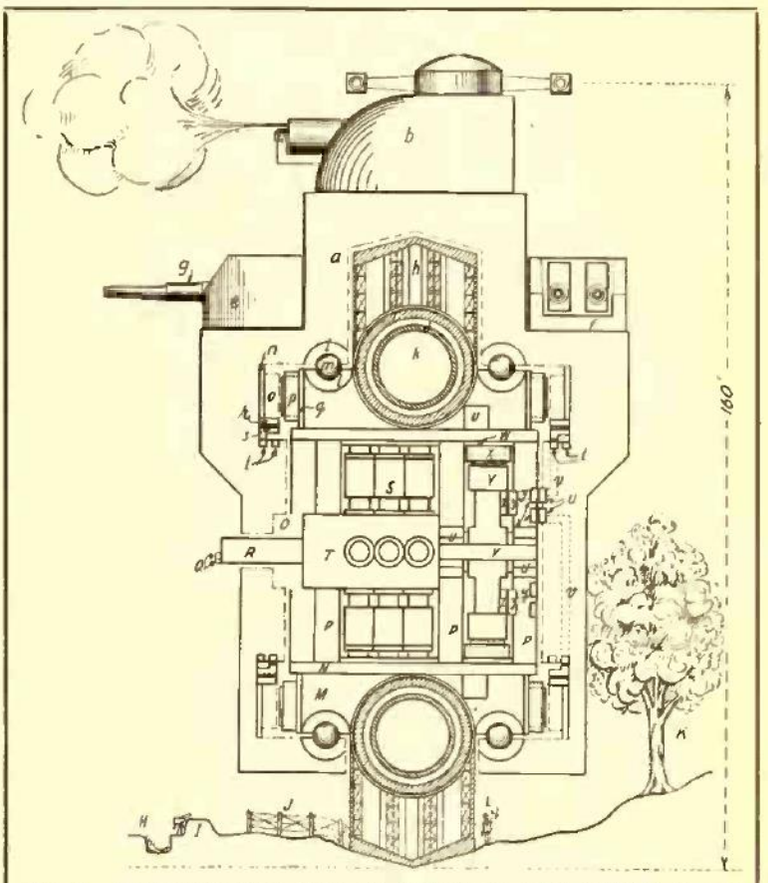

Fig. 2. Front Sectional View of Mastodonic Land Cruiser of the Future. Note Comparative Size of Man Here Shown.

Passing to Fig. 2 we have a detail, vertical cross section cutting the cruiser in a plane passing up through the center of the great wheel. We will follow the latter in explaining this diagram. On top is the crown bridge. It is heavily armored, rotates like a turret and carries the armored range finding arms, the eyes of which are now staring at the reader. Other range finding stations will be located at the top of the first control mast and at various points about the cruiser. It shall be the duty of these stations, not only to obtain the ranges of the enemy's positions, but to maintain an accurate running survey, analogous to the log at sea, from which the exact position and orientation of the cruiser may be told at any time. The complete control of the cruiser will be centered in the crown bridge, but there will be duplicate control stations in the main bridge (a) and at other points. The officer on watch at the crown bridge's range finder will have complete control of the cruiser, and he will electrically train and fire all of the guns, at the same time following the results of his own operations through the huge telescopic range finder.

(b) is the crown turret carrying the six-inch rifle machine gun described; (a) is the main bridge, offices, range plotting rooms, etc. Forward of this, but not shown in any of the diagrams, is the main searchlight station; (e) is a 17-inch gun turret, side view; (f) is the same, but looking into the business end of the guns; (g) is a 17-inch gun; (h) is the bevel-faced and very heavily armored foot or rim of the great wheel.

All inside of the broken line .—.—.—. is part of the great wheel and rotates with it. The armor of (h) is put on in plates parallel to the plane of the wheel, which is to say, perpendicular to the plane of the section. The plates will be welded together, making the rim of the great wheel one solid mass of steel capable of supporting the weight which it must bear and capable of withstanding the enormous centrifugal or bursting effort of the liquid gyroscope—the latter is carried immediately below (h) in (i), (j) and (k).

(i) is a cross section of the lining of alternate magnet coils and iron rings in the tube of the liquid gyroscope; (j) is the space in which is wound the spiral of *non-magnetic* steel which causes the liquid to spiral round the tube in a second rotation impressed upon the primary one; (k) is the hollow propelling ball of iron and steel faced construction, 15 feet in diameter, which floats in the liquid and which is sucked around and around the tube by a rotating magnetic field, just as is the action upon the shell in the proposed electro-magnetic gun: (1) is the section of a ring of heavy welded armor which, like the ar-

(*Continued on page* 587.)

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FEBRUARY, 1917 PHOTO SUPPLEMENT NUMBER 15 CENTS

The Electrical Experimenter

POPULAR ELECTRICAL NEWS ILLUSTRATED

TRENCH DESTROYER

SEE PAGE 714

LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

The Trench Destroyer

By H. GERNSBACK

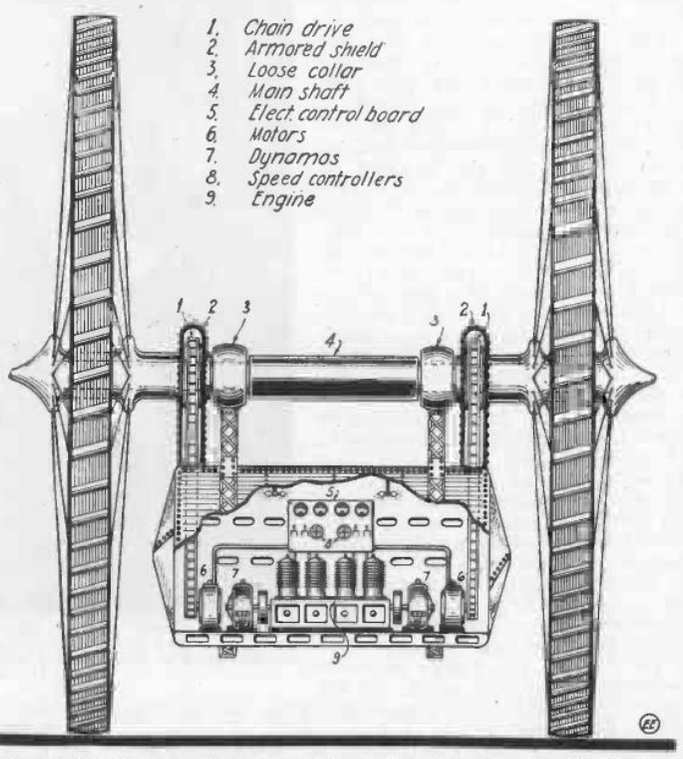
IN the February, 1916, issue of this journal, the author described a formidable war machine, termed the "*Trench Tractor.*" This machine was conceived primarily to force a breach in an existing, well defended trench. Once across the trench, the infantry could force its way thru and then perhaps attack another portion of the trench from the rear, conditions being favorable. As will be remembered, the Trench Tractor was no mere bagatelle, it measuring 140 feet from wheel to wheel, while the tractor wheels themselves were over 40 feet high.

On account of its novelty, the Trench Tractor enjoyed a remarkable publicity. Several hundred American papers and a score of European journals described and discust it, and now, a year after its description in THE ELECTRICAL EXPERIMENTER, it pops up every once in a while. Whether the Trench Tractor will ever be constructed, matters very little; what is more important tho, is that it has set many able people to thinking.

Imitations and *improvements* on the original design have not been lacking, the latest appearing in a New York Scientific Journal as described by one Frank Shuman.

He simply takes the Trench Tractor and enlarges it three or four times. He then added a superfluous third end wheel *for steering purposes,* and palms it off as a brand-new war machine.

Recently we have heard much about the British "Tanks" which are a form of Trench Tractor themselves, but on account of their foolish disregard of war conditions as they actually exist, these "Tanks" at once proved a total failure. The writer is confident that the "Tanks" will not appear again in their original make-up.



View of the "Trench Destroyer," Showing the Electrical and Mechanical Features of the Propelling Mechanism. The Machine Is Steered by Running One Motor Faster Than the Other. Its Speed Varies from 10 to 20 Miles Per Hour and Its Armament Comprises 10 or More Rapid-Fire Guns.

A war machine of this class is at once foredoomed to failure for the following reasons. The "Tanks"—which are mere re-constructed agricultural tractors, carrying armor for protection—cannot advance at a faster pace than 4-6 miles per hour. On account of this ridiculously low speed the enemy finds but little trouble to plant shells upon it. Then again the "Caterpillar" tractor arrangement is a delicate piece of machinery—even a comparatively weak shot into a caterpillar will almost certainly disable the entire machine.

It is with these and other reasons in mind, that the author suggests in this article, a machine which may prove useful in future, to keep armies from entrenching. He has pointed out before that once an army entrenches itself, the usefulness of that army has ceased to exist for its country, except as a defensive measure. No war will ever be won or lost with the opposing armies *dug in,* in trenches. Both are deadlocked, as witness the contending armies in northern France to-day, now entrenched for over two years.

If we can invent a practical machine which will make trenches uninhabitable, wars will not last as long as the present one and consequently much bloodshed will be saved. Furthermore, and of far greater importance, is the fact that once governments come to realize that armies cannot be successfully entrenched, even for a defensive measure, they will be much more reluctant in declaring war upon each other.

Contrary to public opinion, the more terrible war machines can be constructed, the less the likelihood of the *next* war. Each government will be afraid of the other, for with a war fought by machines against machines, the outcome can never be foreseen accurately. In other words, the agressor stands as good a chance of losing as the defender.

As stated above the function of the Trench Tractor was to approach the trench at right angles, *riding* over it, thus making a gap for the infantry to pour thru. This maneuver, however, does not win a trench from the enemy.

The function of the writer's new "Trench Destroyer" is entirely different. It sets out to effectively drive the enemy from the best defended trench—in fact making intrenching impossible.

The Trench Destroyer is not a huge monster but a machine of rather modest proportions. Our front cover illustrates it better than a long, extended description could. There are two broad steel-rimmed tractor wheels, about 30 to 40 feet high and some 2 to 3 feet wide. The outside distance from wheel to wheel is not more than thirty feet. A shaft connects the two tractor wheels, which are operated individually by chain drive from two independent electric motors. A heavily armored car, housing 10 to 12 men, and the necessary artillery and propelling machinery hangs from the connecting shaft. The armored car measures about 16 feet long by 11 feet high, and hangs some 6 feet above the ground.

It will be noted that the wheels, as well as the car and all vulnerable parts of the machine, are so constructed as to be practically shell proof, except for shells of extra large caliber. The wheels are of the open lattice-work type, constructed similar to the American battleship fighting masts. The largest shell will thus pass thru both the wheels with ease and granting that a few spokes are damaged, the machine will not be disabled thereby. As the Trench Destroyer moves at the rate of from ten to twenty miles an hour, it should be rather difficult for heavy artillery to place shells in it accurately. If the pilot of the Trench Destroyer knows his business and runs the machine constantly at varying speeds, it will be almost impossible for the enemy to damage it by shell fire.

At any rate there is nothing delicate on the outside of the car, except the chain drive and this is encased in exceptionally heavy armor. Both extreme ends of the shafts are cone-shaped, to deflect shells. The same is true for the ends of the car body facing the enemy. It is shaped in the form of a pyramid and is thus certain to deflect small shells.

The battle action of the Trench Destroyer would be as follows:—First let it be understood thoroly that a single machine is of but small value; from six to twelve and more are needed if success is desired.

The first Destroyer approaches the trench at right angles. At the edge of the trench (or parapet) it slows down to almost nothing, only one wheel being run slowly. This has the effect of turning the machine around, and parallel to the trench. One wheel—remember it measures thirty feet high—now rides easily over the trench and in a few seconds, the Destroyer is astride over the trench. Power is then applied to both wheels and the machinery gathering speed rides over the trench, one wheel on each side of it. Parapets, wire entanglements, lateral connecting trenches, et cetera, will not impede the progress of the Destroyer. The wheels are so large and heavy, that small obstacles of this sort count for little more than an empty grocery box to a five-foot cart wheel—it simply passes over the obstruction.

In the mean time the ten machine guns—five in front and five in back of the car—have not been idle. They fire away into the trench below, raising terrible havoc as the machine rolls on. If there is much fight left, the next machine continues the work and by the time the last machine has

(*Continued on page 765*)

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

Electric Power From Ocean Waves

By H. WINFIELD SECOR

HAVE you ever been down by the seashore, watching the mighty waves of the ocean rolling in shoreward with their inexhaustible energy, and stopt to realize that if we could effectively utilize this tremendous amount of natural energy constantly going to waste, that we could light every office building, factory and dwelling not only in the United States, but also supply sufficient electrical energy for all of the light and power required in all parts of the world with plenty to spare?

In the past ten years and before that time, there have been numerous inventors who have devised many ingenious and curious machines and auxiliary apparatus whereby to effectually transform this mighty power into a more docile and easily controlled form of energy—such as electricity, which can be easily transmitted hundreds of miles overland thru sinewy copper wires to the point where it is most required. Many patents have been taken out on some remarkable *wave motors,* as they are generally termed, but so far none of them have proved sufficiently practical to warrant their adoption, for several reasons. These include the rise and fall of the tide and the constantly changing form and amplitude of the incoming ocean waves, etc.

The ocean, or rather the oceans of the world, and especially along the sea coast, seem to present wonderful opportunities for the production of electrical energy at practically no cost except the initial one for the installation of the necessary electrical and mechanical machinery.

The illustration which we have the pleasure of presenting herewith shows one of the latest wave motor schemes, devised by Mr. J. Verner. Mr. Verner has several good ideas for the general application of his wave motor, broadly speaking, and a few of the more practical ones are mentioned herein. Not only is this wave motor power plant intended to be efficacious when utilized to develop a few horsepower for such purposes as the illumination of lighthouses along the coast, but he also mentions that with a number of these scattered along a stretch of coast, they can be properly arranged to pass their electrical energy thru submarine electrical cables to shore, where the combined electrical output of a number of these wave motor plants can be arranged with a storage battery, etc., so that a very large amount of power could thus be realized. On the other hand, this design of wave motor plant appears to have a number of good features which might be employed for isolated lighthouses, which would eliminate daily and constant manual attention by anyone.

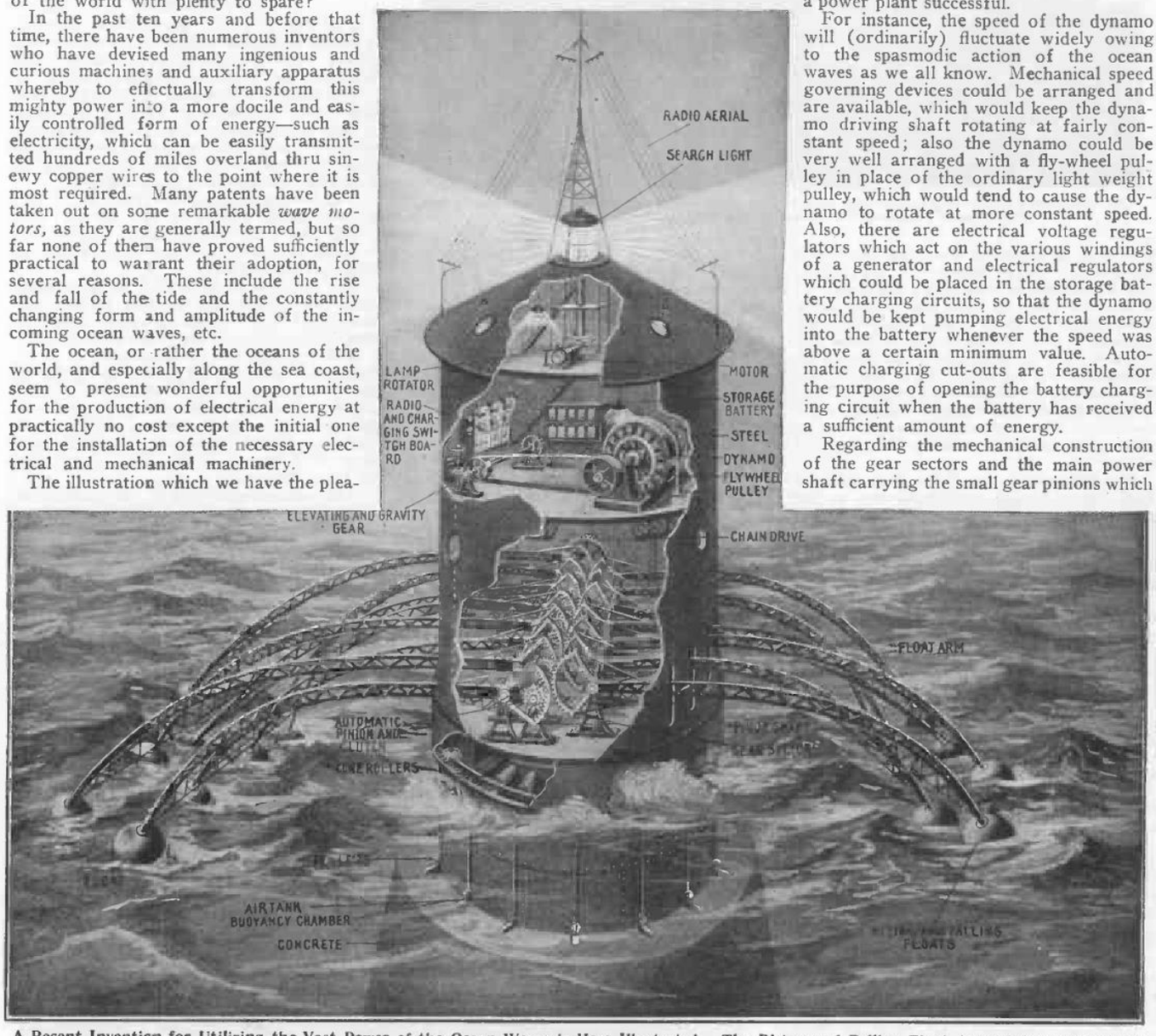
For instance, suppose that the plant shown in the illustration was designed on a small scale, simply to develop five to ten horse-power or even considerably less than this, and that by means of a suitable storage battery and automatic switch-board, the energy developed by the dynamo could be accumulated during the day. As evening approaches the battery current can be switched on to the powerful lamp on the roof of the structure by means of radio control waves sent out by a suitable wireless station on shore. Wireless antennae could be arranged on the roof of the wave motor tower as shown and at daybreak a second wireless impulse intercepted by the antenna would cause the electrical apparatus to open the lamp circuits, and so on.

There are a number of refinements, both electrical and mechanical, which are already in use in many applications of electrical and mechanical engineering, which could be very easily adopted to make such a power plant successful.

For instance, the speed of the dynamo will (ordinarily) fluctuate widely owing to the spasmodic action of the ocean waves as we all know. Mechanical speed governing devices could be arranged and are available, which would keep the dynamo driving shaft rotating at fairly constant speed; also the dynamo could be very well arranged with a fly-wheel pulley in place of the ordinary light weight pulley, which would tend to cause the dynamo to rotate at more constant speed. Also, there are electrical voltage regulators which act on the various windings of a generator and electrical regulators which could be placed in the storage battery charging circuits, so that the dynamo would be kept pumping electrical energy into the battery whenever the speed was above a certain minimum value. Automatic charging cut-outs are feasible for the purpose of opening the battery charging circuit when the battery has received a sufficient amount of energy.

Regarding the mechanical construction of the gear sectors and the main power shaft carrying the small gear pinions which mesh with the toothed sectors on the steel float arms as shown, there would of course ordinarily be created a to-and-fro motion of the main shaft as the floats rise and fall. To overcome this the float arms are only actively employed in the production of power with which to drive the dynamo during their upward travel, *i.e., when the waves force the floats upwards;* when they descend they cannot transmit mechanical energy to the main shaft, as the pinions

(*Continued on page 775*)



A Recent Invention for Utilizing the Vast Power of the Ocean Waves is Here Illustrated. The Rising and Falling Float Arms Act on a Common Power Shaft to Drive a Dynamo, which in Turn Charges a Storage Battery. A Radio Controlled Light-House is Shown Above, Fitted With Such a Wave-Power Electric Plant.

Baron Münchhausen's New Scientific Adventures

By Hugo Gernsback

Martian Atmosphere Plants

GAZING thru my faithful three-inch telescope upon the dazzling plains and extinct volcano ranges of the Moon, often set me wondering in the past. Everything appears dead, everything spells desolation on a tremendous scale. No atmosphere seems to exist, no green or brown patches greet our eyes from which we might infer that the moon harbored vegetation. Nothing but brilliant, white uniform wastes. For there cannot be vegetation, as we understand the term, where there is no atmosphere to support the plant life.

But was it always thus? Geological science here spells an emphatic NO. Eons upon eons ago the moon must have had an atmosphere as has our earth. Gradually, due to the very small gravitational attraction of the moon, its air must have slowly left it to vanish into space, never to return. A slow process, to be sure, but steady nevertheless.*

What dramas must have been enacted on our now dead satellite before the last creature died, gasping its last breath! What tragedies there must have been enacted before the last intelligent creature—if there were such—finally bowed to relentless nature. Did these creatures put up a fight against certain extinction before they accepted the inevitable, or did they let nature have her own way?

These were questions I frequently asked myself when gazing upon our dead companion world, questions which probably will not be answered for a long time, if ever.

I was more than pleased for this reason, that the moon, not being willing to tell me her riddle, another dying world—Mars—should volunteer certain information which might shed new light upon the question.

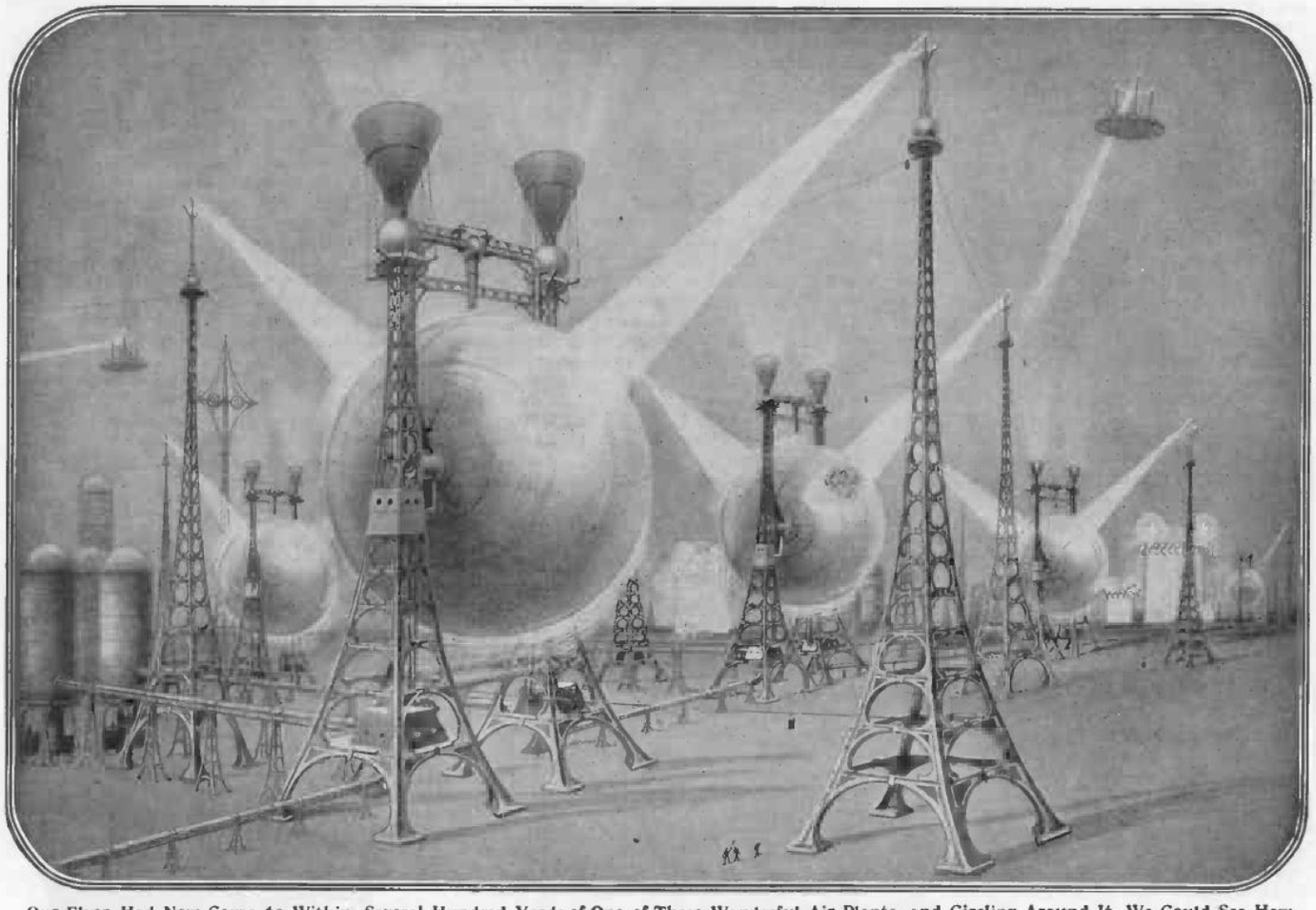
* * *

I had scarcely hooked up my latest Radium Amplifier to my Ultra-sensitive Radio receiver, and balanced the vibrant Photostat, when dear old Münchhausen's voice filled my laboratory through the loud-talking telephone relay. His voice came in clear as a bell and even I had difficulty in realizing that this voice did not originate a few miles away from my aerial, but some 80,000,000 miles distant, hurled through an unthinkably vast ether-ocean, a distance so great that the human mind fails to comprehend it.

"Greetings, my dear boy," Münchhausen's sonorous and sympathetic voice was sounding, "am rather lonesome this afternoon and anxious for a one-sided chat. If only I could hear that dear voice of yours, as I did when I was still on *Luna!* You see I actually have not heard a human voice for days. Professor Flitternix and I are becoming so *Martianized* that it is no longer good form to talk aloud when it is easier to converse by thought transmission. We are so proficient in the (to us) new art, that it is now a rare occasion when we utter a word. This is more an ancient habit than a necessity, because we can converse ever so much faster by thought transference than by spoken words. But our barbaric custom still clings to us, and for that reason it does me real good whenever I have occasion to talk to you! If only you had a sufficiently powerful sender to talk back to me. Ah! would that not be delightful? But on second thought, who knows that it is not better as it is? You might ask me too many pertinent questions. And besides, we have not been on Mars sufficiently long to know much. We are still very VERY young puppies, blinking uncomprehendingly about us in a wonderful and ancient world, with far too few senses to appreciate all that continuously goes on about us.

What we see and hear I am convinced is insignificant as to what we cannot see and cannot hear. This was thoroly demonstrated to us only to-day.

Flitternix and myself, accompanied by two of the Planet Governor's attendants, were walking about the elevated streets of the Capital City, taking in the sights. We



Our Flyer Had Now Come to Within Several Hundred Yards of One of These Wonderful Air Plants, and Circling Around It, We Could See How Tremendous Its Size and How Marvelous the Minds That Built It.

*NOTE.—It is assumed that the exceedingly attenuated "atmosphere" which Münchhausen reported during his visit to the moon, is of comparatively recent origin; it is probably of a volcanic nature.

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Why Not Aerial "Stepping Stones" from U. S. to Europe?

By F. S. WINGER

Each "stepping stone" a gigantic floating fortress, and the distance between each one 200 miles let us say. A constant stream of aeroplanes could thus fly from the United States to Europe—20,000 of them in one year—predicts the author of this interesting article. Radio messages could be relayed from one "stepping stone" to another with much less chance of interference and interception as at present.

It is admittedly impossible at present to attempt flying the entire aerial fleet of Uncle Sam across the ocean, however much it might expedite the delivery of the promised 20,000 aeroplanes to our Allies. Here's a unique and feasible plan—feasible at least under this war's conditions, with Germany's battle-fleet bottled up—which is proposed by a Chicago genius and author—Mr. F. S. Winger, who originally conceived this idea and described it in his book, "The Wizard of the Island," altho in that work the idea has not a military dress. The present article prepared for the ELECTRICAL EXPERIMENTER *by Mr. Winger, describes his latest ideas in this direction.*

* * * * * *

MAKE each "Stepping Stone" a huge float—each float a veritable floating fortress, defensively armed and equipt to meet any emergency which the enemy could menace them with, which under the conditions of their bottled-up-Navy would probably be limited to their submarines.

Each float to carry a supply of stores, maintain a repair department, etc., and to have just sufficient mobility to enable it to successfully oppose any drifting tendency on the part of either ocean or air currents, so that they could maintain a fixt latitude and longitude—their chief purpose.

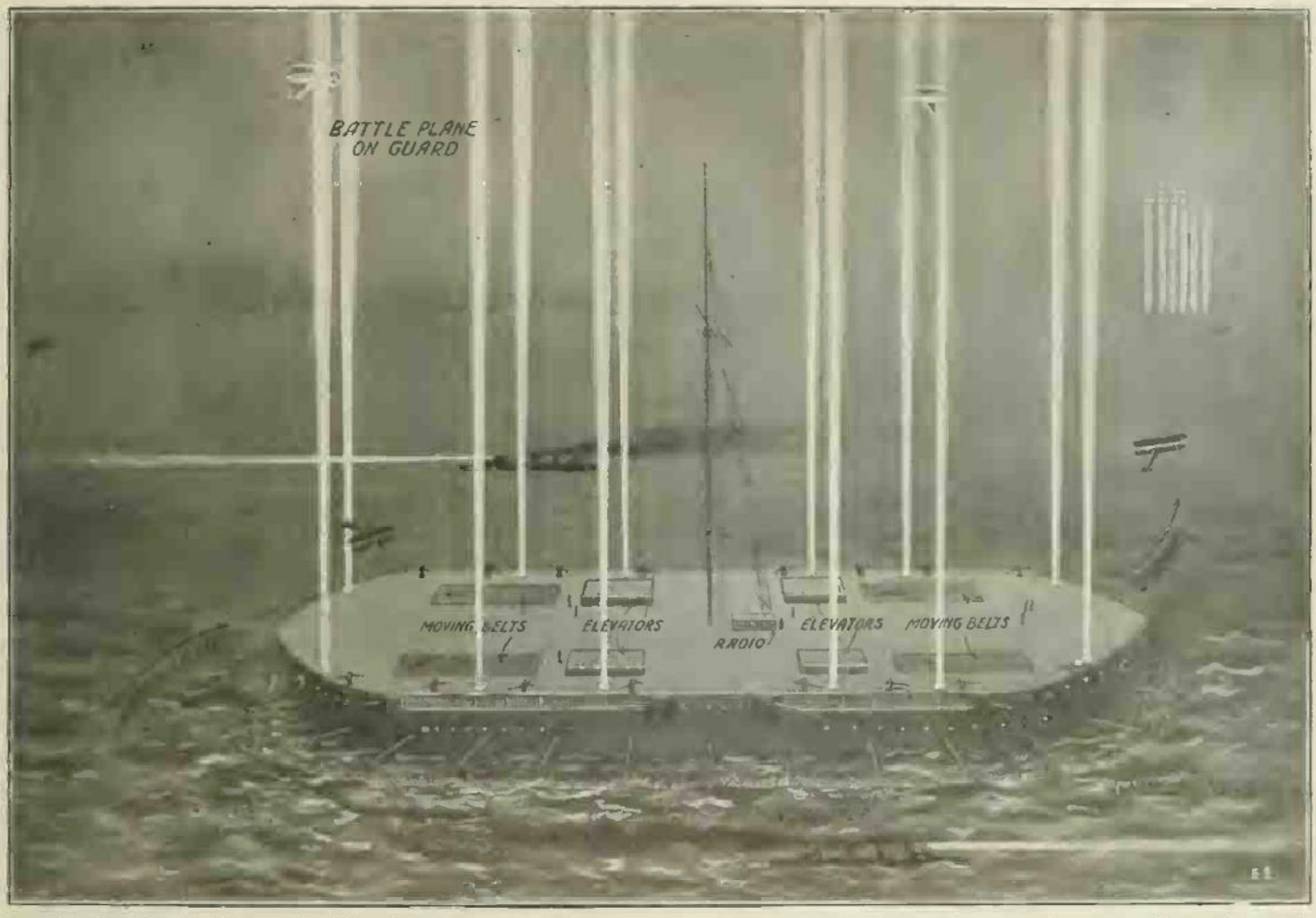
Should such craft be maintained successfully and be constructed along lines for the temporary accommodation of an endless stream of aeroplanes emanating from the shores of America en route for Europe, then, in my humble opinion, one of the most difficult of our problems will have been solved.

Under existing conditions a single pair of wings of the average type of aeroplane is a very bulky article for the hold of a ship at best, as when boxed its cubic contents would be represented by a bulk approximately three feet by five feet by thirty-five feet. Think of the tremendous storage space these alone would occupy, with the possible and even probable eventuality of their being destroyed by a submarine torpedo. Furthermore should all the parts successfully reach the shores of France or England, even then the air-craft would have to be unloaded, unboxed and reassembled, and then assigned to an aviator who had encountered the same dangers as in the instance of the knocked-down planes. Then think of the other situation by way of comparison both aviator and airship will have reached their destination without such hazard, and both ready for immediate service when they land; the aviator accustomed to the idiosyncrasies of this particular plane—in fact having been in actual continuous service while becoming acquainted with his machine!

Suppose that it would take twenty hours of actual flight to reach the shores of France or England. The aeroplane would still have from seventy-five to eighty hours of usability left before requiring replacement of wornout parts.

The "floats" would necessarily have to be very large, with top deck free from obstructions so as to facilitate the safe landing of the airships. The process of accommodating the stream of aircraft might be

(Continued on page 717)



Instead of Shipping the Thousands of American Aeroplanes Across the Ocean, Mr. Winger Has Made the Unique Suggestion Here Illustrated Namely—Have a String of Gigantic Aerial "Stepping Stones" Across the Ocean and Let the Aviators Fly Their Machines Over. These Armored Ships Could House Dozens of 'Planes at Night, When Necessary, and They Would Be Marked at Night By Powerful Vertical Shafts of Light.

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A Gyro-Electric Destroyer

By H. GERNSBACK

WE are primarily in this war to win it and to win it quick. This war has demonstrated the fact that men against men result unavoidably in a deadlock. There is but little doubt that any of the men of the warring nations today are not as good as those of any other. If we are to win the war, we will win it with machinery. As this war has demonstrated and keeps on demonstrating right along, it is a conflict of machines vs. machines, and the nation that has the best and the biggest machines is most likely to win out in the long run. America with its inexhaustible mechanical resources should and can do much towards shortening the war, and it is absolutely certain that if we do not bring into the field monstrous machines capable of smashing thru anything, then the Germans will do it.

America has the resources and the brains to accomplish the result. It is simply a matter of doing it, and doing it at once. Let our officials ponder over the logic and truth of this statement. It is bound to arise again.

If proof were needed what machinery has been able to accomplish in this war the recent advance of the English by means of their ponderous Tanks before Cambrai, would be a good example. Likewise, the German 42-centimeter guns have given us a good idea that, given sufficient machinery, most any obstacle can be battered down.

It has been the pet contention of the ELECTRICAL EXPERIMENTER for years that the big machine is *the* thing in modern warfare. In our February, 1915, issue, long before the present Tank made its appearance on the Western front, we already pictured a ponderous machine that could be used to batter down not only trenches, but any kind of fortress as well. In this same issue, we also depicted a huge two-wheeled affair which we termed a "Trench tractor," and this monster was supposed to make trench warfare impossible. There was much publicity accorded these various designs as well as very much ridicule, as it was not then believed that the big machines were what we claimed for them.

Just the same, our ideas were the forerunners of the present British Tanks, and in February, 1916, the first British machine was completed and taken down to a farm near London. In this locality pits, trenches and various fortifications had been destroyed so satisfactorily by the Tank, that an order was given at once for one hundred machines. The first delivery of the British Tanks was made in July, 1916. As is well known the first British tractors went into action in the Somme offensive which began on September 15, 1916. The object of the Tanks was to drive the Germans out of some high ground running east and south of Thiepval. The Tank having the element of surprise, the Germans in the first assault were driven back quite a little, but they soon rallied, and began to shell the various slow-moving Tanks.

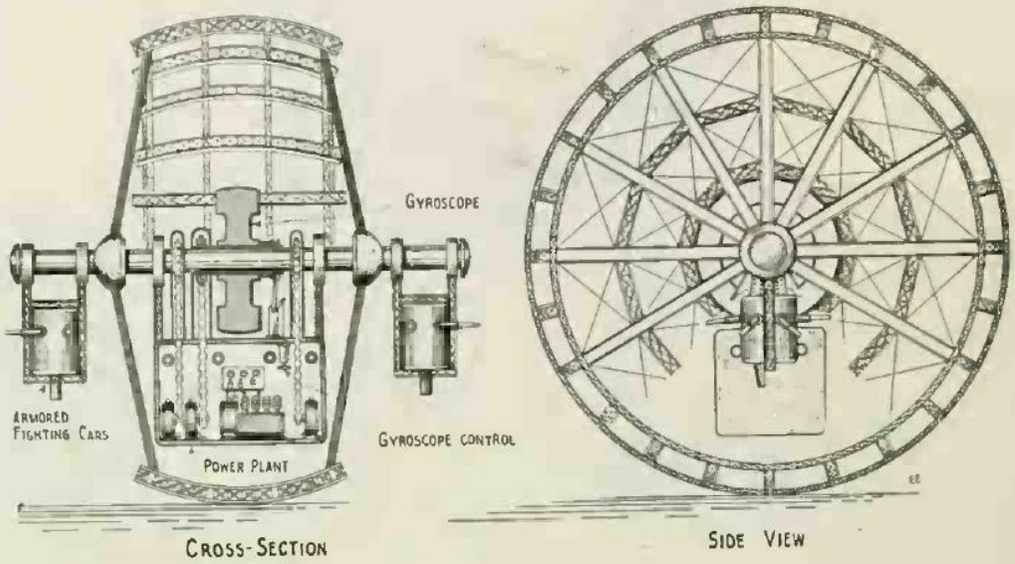
Now it is not our intention to minimize the results or the successes of the British Tanks, but at the same time, as we have pointed out before and insist in pointing out again, the British Tanks as constructed today do not lend themselves for major operations. They are all right for a surprise attack, as at Cambrai, and it is quite doubtful in our mind if such a performance can be repeated, as the Germans by this time have learned their lesson well.

The great trouble with the Tank is its very slow speed. No tractors have been constructed so far that can move at more than eight to ten miles an hour, and as such they become easy prey to the enemy's guns which readily get the range of the slow-moving vehicles, and begin to shell them. While the British claimed no losses in the last Cambrai offensive, the Germans claim that they shot twenty Tanks to pieces. Presuming that this amount is exaggerated, there probably is quite a good deal of truth to it.

Attention is called to the fact that the movable belt tread of the Tank is quite a sensitive affair. If hit, even the bullet of a small caliber gun will almost certainly cripple the Tank. The belt is the most vulnerable part of the tractor, and as soon as it stops moving, the Tank stops moving as well, and as far as offensive work is concerned, the machine is out of action.

As we have pointed out before, what is wanted is a machine, not necessarily monstrous and weighing many thousand tons, as much as a machine that need not weigh more than the present Tank, but that can cover ground *rapidly*, so that it becomes almost impossible for the enemy to get the range.

In view of the fact that the United States Government is seriously contemplating to equip our national army with Tanks, we wish to voice our strong opposition against them, as being unfit for the important work that they are supposed to do. We have in the past issues shown designs of large machines which could batter down barbed wire entanglements and which were to be used in offensive work, but we believe that the machine here described has all the good qualities of the present Tank, but none of its many faults.



Sectional View Thru Front and Also Side View of Mastodonic "Gyro-Electric Destroyer." It Measures 45 Feet in Height and Can Progress Over Trenches, Barbed Wire and Gun Emplacements at 40 to 60 Miles Per Hour, Instead of Creeping Along as Do the "Tanks."

Transportation of war stores to the Western front at the present time is quite a difficult problem for the United States. It becomes a huge task just now to ship even one hundred Tanks to Europe, as they take up a tremendous amount of cargo space. In contradistinction, the machine described in this article could be shipt knocked down, the entire frame work of the wheel being made of channel iron, which takes up very little room. This is a large item, and should be carefully considered, as no doubt it will.

The present gyro-electric destroyer is a single steel wheel as clearly shown in our front cover and accompanying illustrations, about 45 feet high. The top of the wheel is not flat, but is in the shape of an arc which makes running a good deal easier. The wheel itself looks like a huge *ferris wheel*, and is constructed of channel steel thruout; in order to make it as light as possible, it has no continuous tread or rim but rather the steel pieces at the circumference are spaced about one foot apart, leaving a clear space for two reasons. First, the weight is cut down. Second, as our front cover illustration depicts, much better purchase is had on the ground, the machine not being apt to slip as would be the case if the top of the wheel was solid.

The wheel has one large shaft passing thru the center and extending at each side as shown in the cross-section in our illustration. This shaft is hollow and need not weigh very much. It is constructed of steel. At the hubs and at the ends of the shaft the latter is provided with armored projections, which will not be damaged in case of shell fire. In the center of the wheel is suspended the engine cab which comprises a gasoline engine of some three hundred to five hundred horsepower, the energy being fed to a generator as shown. Two of the electric motors are used for

AMONG the hundreds of new devices and appliances publisht monthly in The Electrical Experimenter, there are several, as a rule, which interest you. Full information on these subjects, as well as the name of the manufacturer, will be gladly furnisht to you, free of charge, by addressing our Technical Information Bureau.

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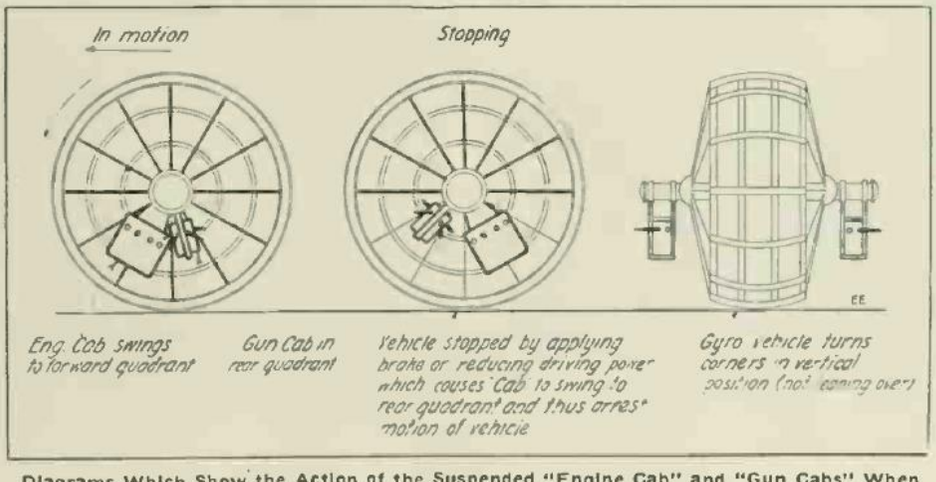
propulsion of the wheel only; they are attached by means of a chain drive to the central shaft as shown.

It will be understood by studying the illustrations that as soon as the motors start operating, the engine cab swings forward while the wheel moves forward also. The heavy weight of the engine cab prevents it from turning a somersault as it were, but it does swing forward, and in case the vehicle is to be stopt, the cab must swing backward as shown in the illustration below. The engineer thus has it in his power to run the destroyer fast or slow, simply by changing the speed of his motors. It should also be noted that only a very moderate speed of the motors is necessary, being that the diameter of the wheel—45 feet—is so large that it will move at the rate of from forty to sixty miles with the motors running at very slow speeds. So much for the power plant.

Our attention is now called to the fact that we must steer the destroyer and steer it quickly. To accomplish this, advantage is taken of the gyroscope, which lends itself admirably to this work. The cross-section of one of our illustrations shows how this is accomplisht. A huge cast-steel gyroscope wheel is stationed on the central shaft and is driven rapidly by means of a special electric motor as shown. The gyroscope wheel while in motion, of course, prevents the destroyer from toppling over, but the writer has incorporated a new idea in the device, whereby it becomes possible with a single gyroscope to steer the vehicle. By shifting the gyroscope wheel either to the left or to the right, the vehicle will "turn" momentarily, all depending on the amount of shifting of the gyroscope, and this shifting need not be very much. If the gyroscope wheel is shifted to the right, the machine will move to the *left*. If the wheel is moved to the left, the destroyer will move to the *right*. Attention is called to the fact that this *"leaning"* is *very slight*, as the gyroscope tends to keep the machine in its upright position always. For instance, the destroyer will turn corners, not by leaning at a picturesque angle, as might be supposed, but it will actually turn corners in a vertical position, due, of course, to the gyroscope which tends to keep the wheel in its upright position always. No technical difficulty is occasioned in this gyroscopic drive or control, and any engineer familiar with gyroscope work should be able to work out the details of the machine readily.



Diagrams Which Show the Action of the Suspended "Engine Cab" and "Gun Cabs" When Gyro-Electric Destroyer Is In Motion; When It Is Stopped and When Turning Corners.

At the two sides of the wheel we note the armored gun cabs. These can be round or square as may be desired; they hang from the shafts by means of loose slip rings. As there is nothing to hold them back, the two cabs will move backward due to their inertia while the machine is in motion; they will move forward for the same reason when the destroyer is suddenly stopt. Our illustrations show this clearly.

These armored cabs have the usual guns, the same as the British tanks, and they also have a bottom tube for the discharge of bombs as shown. All the offensive work is carried out by the two-gun cabs, the engine plant not being used for offensive purposes whatsoever. It is simply a power plant.

Inasmuch as the wheel of the destroyer is not solid, but made of channel steel, it will be readily understood that even a large size shell will easily pass thru the lattice work of the destroyer without doing much damage, and here is where this machine shows its superiority over the tank. It will be almost impossible to damage this destroyer by means of shell shot. Even a "dead hit" from a medium caliber gun will not cause much damage, and even a good sized shot hitting the gyroscope will not hurt it very much for the reason that the latter spins at enormous speed and will be almost certain to deflect the shot, unless, of course, it is a dead hit at right angles to the face of the wheel. The external chain drives are encased in heavy armor, and it should be as heavy as possible to prevent the machine being put out of action, and this can be readily done. It will be noted that this chain drive, the most vital part of the machine, presents but little surface to an on-coming shell. In contrast thereto you will notice the broad and very large moving tread of a British tank, which comprises almost one-quarter of the surface of the entire tank.

Reverting back to the gun cabs. There is really no good reason why these cabs are needed at all. Nor is there any good reason why the British tanks should carry guns. If the machine was at all built for offensive purposes, its weight alone would be sufficient to crush down any opposition, thereby making the guns useless. This is exactly the purpose of the present machine. Imagine this machine starting on its offensive journey. It will first smash thru all the barbed wire entanglements without any trouble whatsoever. It simply mows them down as so many match sticks, thereby cutting open a path for the infantry that follows. Suppose a nest of machine guns is encountered. Our guns become practically useless, for if the destroyer runs over the machine guns or even threatens to do so, the enemy must of necessity abandon the guns, and the destroyer "walks" over them, crushing them into the ground. The same is the case with the large size guns. You may be quite sure that if the gunners see the machine coming, they will most certainly abandon their gun, and in this case the destroyer is powerful enough to run over the gun, thereby putting it out of action.

This machine is not designed, as might be supposed, to kill off as many of the enemy as possible. That is not at all the purpose of the machine. It is simply to put out of action other machines, preferably guns, not men. Its first purpose is to cut down barbed wire entanglements—second to run over artillery, thereby putting it out of action. If we employed enough destroyers, it can be readily conceived how the enemy must invariably retreat as soon as these machines begin to advance, for the enemy denuded of all artillery must give up ground.

Some of these destroyers would, of course, be used to run parallel to the trenches, and here is where the gun carriages of the destroyers would come into their most effective work. They could drop bombs into the trenches as well as spray the occupants with machine gun bullets in order to demoralize the men in the trenches. It would become a more or less simple task to take trenches by means of this machine, but, of course, the most important part would be to destroy the larger artillery behind the supporting lines of the enemy. This the huge machines would do without any trouble whatsoever. There is practically nothing known today that could stop the progress of the destroyer. Of course this machine cannot climb steep mountains, nor ford deep rivers, but then the present tanks can not accomplish this either. But the gyroelectric destroyer can run up a hill by taking a zig-zag or oblique course. Rivers that are not too deep can be readily negotiated by running thru them obliquely, not fording them at right angles.

We are quite confident that a machine of this kind should do as good work as a thousand men in the field, and, perhaps, better.

NEW CODE RULE WILL REQUIRE POLARIZED WIRING.

At the recent meeting of the Electrical Committee of the National Fire Protection Association for revision for the next edition of the National Electrical Code, it was voted to change Rule 26*a* as follows:

"The neutral conductor of all three-wire circuits and one conductor on all two-wire circuits must have an identifying insulating covering readily distinguishing it from other wires. This wire must be run without transposition thruout the entire installation and properly connected at all fittings to properly identified terminals in order to preserve its continuity. When one of the circuit wires is to be grounded, the ground connection must be made to this identified wire and as prescribed in Rule 15 and 15*A*."

This rule will appear in the new edition of the Code, to be known as the 1918 edition, and does not become effective until January 1, 1919. All fittings having wire terminals, such as sockets, receptacles, cut-out bases, attachment plugs, etc., must have some identifying mark to enable them to be easily connected with the proper terminal. Therefore, the organization known as the Associated Manufacturers of Electrical Supplies has submitted the matter to members of all of its sections covering the devices affected, asking that proper committees be appointed to consider the matter and report results at as early a date as possible, in order that they may be fully prepared for the new order of rules when in effect January 1, 1919.

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ELECTRICAL EXPERIMENTER

SCIENCE AND INVENTION

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THE AUTOMATIC SOLDIER

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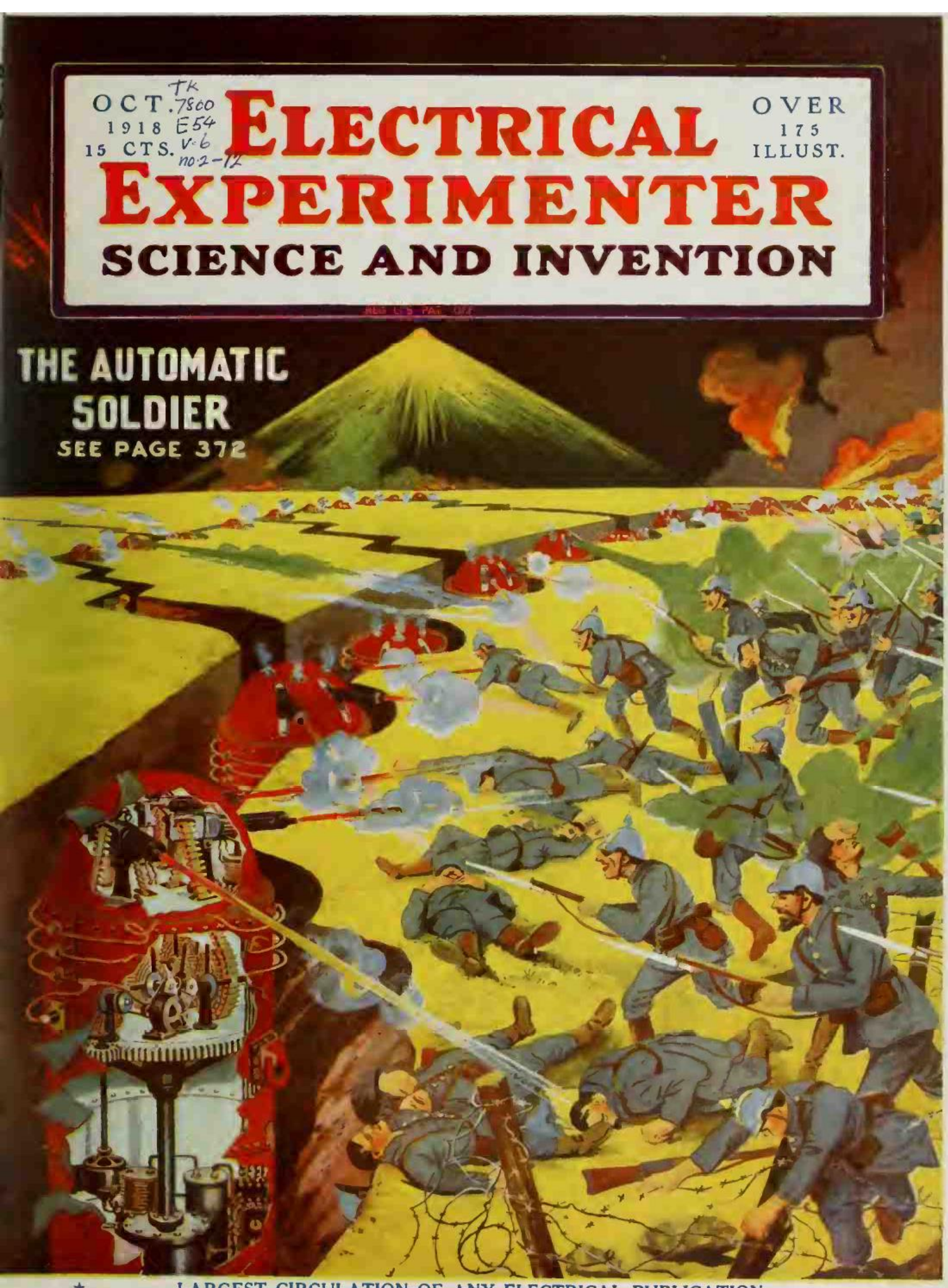

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Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

Vol. VI. Whole No. 66 OCTOBER, 1918 Number 6

OUR NEW 400,000 C. P. AEROPLANE FLARES

FOR carrying out night operations under war-time conditions the Teutons, as well as the Allied air forces have often resorted to the use of "flares" as they are called. These are usually dropt from airplanes or dirigible balloons and, suspended from parachutes, they give an intense illumination over considerable areas.

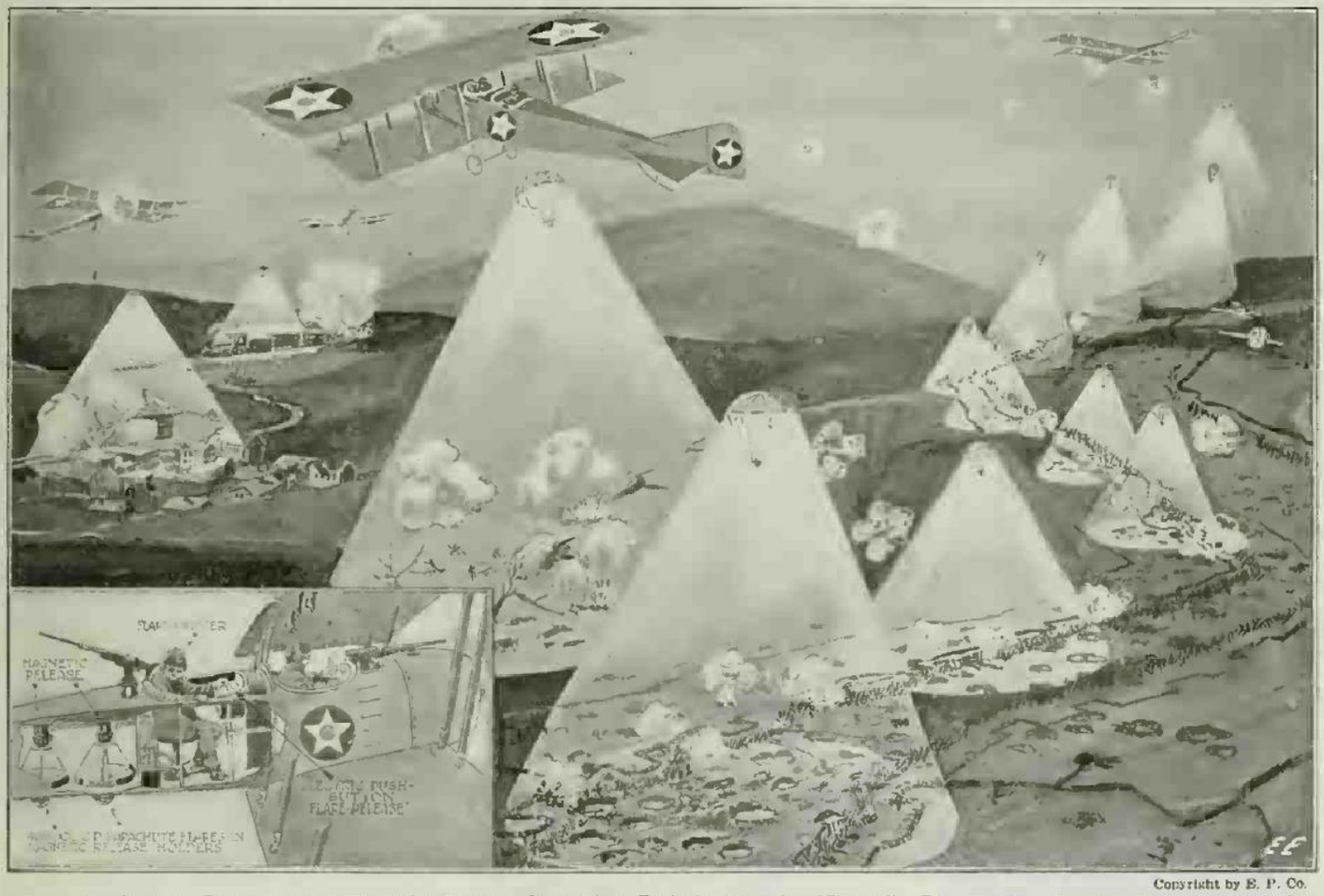
Uncle Sam's ordinance experts have something new to spring on the "All Highest" shortly—a new "flare" light that will give 400,000 candle-power, and light up a circular area one and one-half miles in diameter!

An airplane flare with a brilliancy equalling that of 400,000 candles has been perfected, says our official report from Washington. When hanging from its parachute over a German munition plant it lights up an area so brightly that an airman, thousands of feet in the air, can select any building he is directed to make a target for his aerial bomb, and, it may be added, American aviators are becoming so expert in bombing that they can usually hit the target at which they shoot.

In every European city within the zone of aerial raiding operations, the rule is rigidly enforced against the burning of lights in any building that might possibly be used as a target. Therefore, the airman must be able to supply his own means of locating the object of this attack.

When orders are received to bomb, say a particular railroad center, the aviator proceeds very much in the same manner as does the captain of a vessel. The cities and their environs are charted and the night-flyer proceeds by compass, due allowance, of course, being made for atmospheric conditions. He is also frequently aided by prominent markings, such as the reflection of moonlight from a river.

Having reached the particular district



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Uncle Sam's War Experts Have Recently Evolved Something Entirely New in "Flares." This Design Permits of Launching the "Flares" from Aeroplanes, and the Powerful, Prolonged Illumination They Provide Will Make the Visit of our Nocturnal Aerial Bombers One of Extreme Anxiety to the Inhabitants of German Towns and Cities. Each "Flare" develops 400,000 Candle-Power and Lights up an Area One and One-Half Miles in Diameter.

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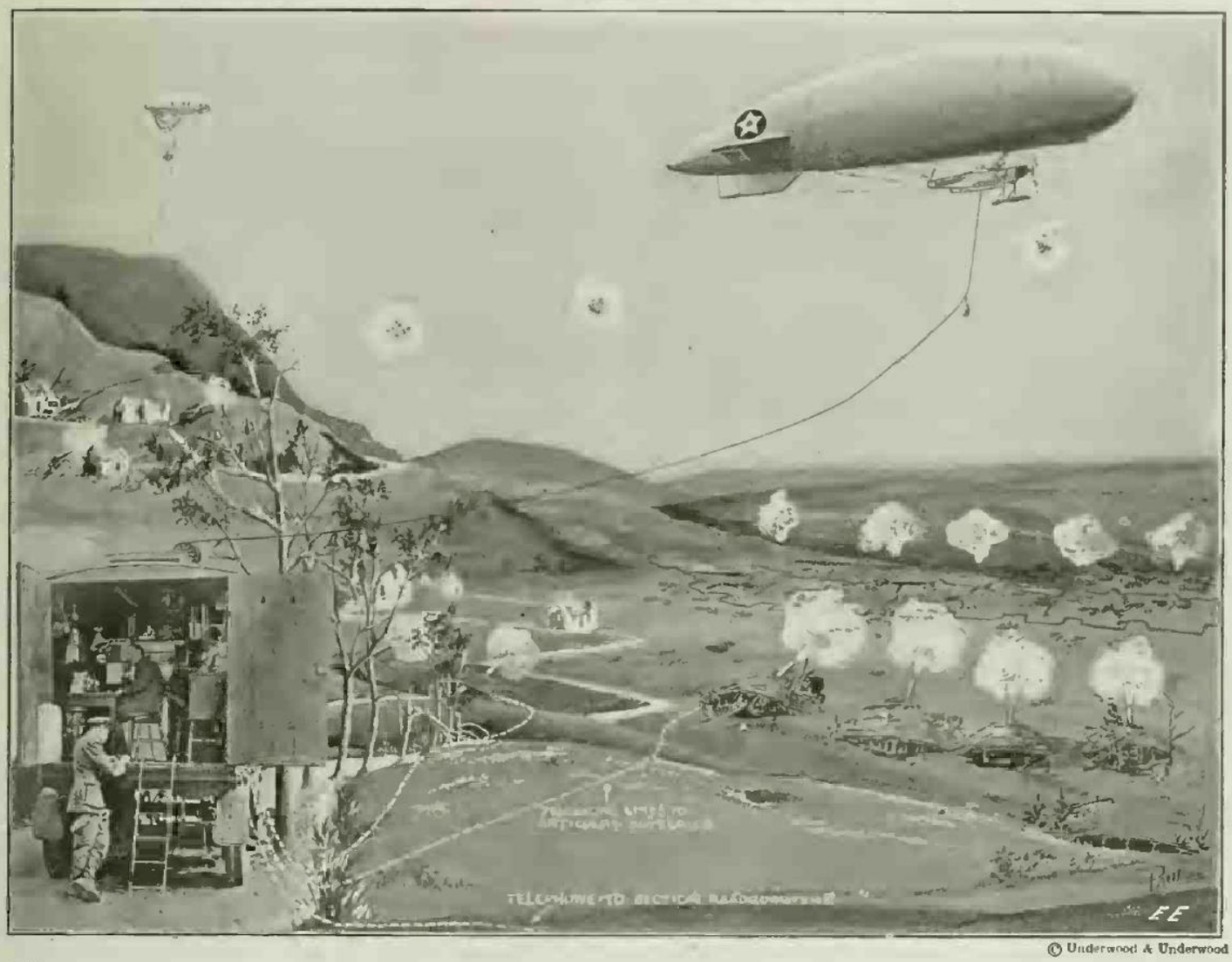
How "Blimps" and Telephone Aid Artillery

THE accompanying illustration shows a Telephone Exchange Lorry of the British Royal Air Force in communication with a dirigible balloon. Many of these balloons are used for observation purposes and the observer has to be ready for almost any emergency, as he is in constant danger of being attacked by enemy shell fire or aircraft. Should the observer be attacked he descends by means of a parachute. The observer is connected to this Lorry by telephone by which he can communicate with headquarters.

The balloons used for the purpose are of several types, some being of the simple gas-filled "blimp" variety, held by a steel cable from the upper end of which they swing about in the breeze, while others are of the dirigible gas-filled design here illustrated. The dirigible carries a gasoline engine power plant and propeller at the front of the nacelle or crew's basket, by which means it can move about in the air and maintain any desired position in a considerable wind. The dirigible balloon does not have to depend on an anchoring cable and winch to pull it down, but can ascend and descend by its own power, suitable rudders and planes being fitted to it for the purpose.

The majority of the balloons used for army observation purposes are plain blimps, anchored by a steel cable to a quick-acting drum or winch on the ground. It is interesting to note that these balloons are often filled with gas (hydrogen) made by electrolytic cells. The U. S. Army balloon school at Ft. Omaha, Neb., has one of the largest electrolytic gas generating plants existant. These generators have a series of large cells fitted with oppositely charged plates which are immersed in water. The passage of the electric current thru the water decomposes it into its constituents—hydrogen and oxygen gas (H_2O). The hydrogen gas is led off thru suitable passageways and pipes and fed into the balloons in their "beds." There are fifteen balloons now in use at Ft. Omaha.

This balloon instruction camp, one of the most efficient and best equipt, has recently installed besides the electrolytic gas generator, the first *silicon* plant in this country. In this new form of balloon gas plant hydrogen is made from caustic soda and ferro silicon. As many as twenty-two steel bottles, each with a capacity of 2,000 cubic feet, under compression of 200 pounds to the square inch, are filled in a single day. In actual war service on the battle-fields of Europe, powerful motor lorries, each loaded with several dozen of these gas bottles are dispatched to the various balloon depots as required. Sometimes the bottles of several trucks are all connected up to a common pipe leading to the balloon "beds."



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What Would the Artillery Officers Do Without the Scout 'Planes and "Blimps?" They Would Be Lost, for the Observers Who Fly About Midst Bursting Shrapnel Are the Men Who "Spot" and Telephone the Exact Ranges and "Shell Hits" to the Artillerists Below. A Dirigible "Blimp" Is Seen in the Foreground In the Act of Ascending. The Telephone Exchange Lorry Is One Belonging to the British Royal Air Force. The U. S. Army Is Training Many Students for Balloon and "Blimp" Observation Work.

To be a balloon observation officer is a real distinction, for besides being fully at the mercy of enemy aeroplanes, who may pump him full of bullets before he can down the attacker with his rifle or Hotchkiss gun, he must be an accomplished map reader and map draftsman—not to mention the knowledge of spotting shell hits instantly, radio operating, telephony and telegraphy, balloon rigging and maneuvers, weather forecasting, et cetera. When the balloonist leaves the U. S. Army school he must know all these things and many more, and be able to note and record shell hits at a distance of four miles.

An electrically operated vacuum cleaner for the teeth has been patented. Let's introduce them to our after dinner speakers!

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The Automatic Soldier

By H. GERNSBACK

As science advances, and as all sorts of infernal machines are thrown into a modern war, the men in the front line trenches become less and less anxious to bear the full brunt of high explosive shells, gas attacks, liquid fire and what not. No matter how courageous a body of soldiers, their morale is bound to deteriorate considerably under a murderous mustard gas attack, or under a modern barrage.

As has been so often demonstrated in this war, if the men in the first and second line trenches can be demoralized, the enemy as a rule can tear quite a gap into the lines, and make his assault in strength. If we could devise some sort of a soldier who was bomb and shell proof and who did not mind either liquid fire or the most vicious kind of gas, our front line trenches would be very much more secure than they are now. It would be difficult to storm such trenches.

This is exactly what a Danish engineer has had in mind when he recently obtained patents on a device which he terms an "Automatic Soldier." Trials recently made with a model automatic soldier are reported to have been eminently successful.

Our front cover as well as the accompanying illustration shows the device clearly. The automatic "soldier" briefly consists of a special double steel cylinder made of shell-proof Tungsten steel or the like. There is one outer, stationary cylinder and a second inner cylinder, the latter telescoping into the stationary one. The entire device is set into trenches as shown in our illustration, the contrivance taking the place of a human soldier. These automatons may be spaced from one to three yards apart, and the operation is as follows:

As already mentioned, there are two cylinders—one, the outer, in the form of a can, and the inner one, in can-shape, too, but with a dome at the top. The inner cylinder rises up and down vertically and normally the dome is level with the surrounding land. When the "soldier" goes into action, the inner cylinder rises eighteen inches, which brings it above the parapet of the trench. In other words, the automatic soldier normally is invisible, and only can be seen when the inner cylinder rises. The guns as well as the entire mechanism are entirely controlled by wireless, operated from five or more miles at a distance. If the commander wishes to open battle with his automatons—after the aerial observer has reported the approach of the enemy—he merely notifies his wireless control station, which immediately sends out impulses, and these in a well-known manner operate the automatic soldier.

The first impulse raises the inner cylinder above the trench. The second impulse pushes the machine guns thru the slots of the dome, while a third impulse may rotate the inner cylinder so as to direct the fire. The fourth impulse may set off the machine guns, each of which, according to its inventor, is able to fire four hundred rounds into any given direction.

Our front cover shows the disposition of the aerial wires which encircle the main steel cylinder.

It goes without saying that the fire of the machine gun can be stopt by radio by sending out the correct impulses at any desired moment. The aerial observer flying over the trench lines containing the automatic soldiers sends back his wireless reports so that the fire of the automatics can be directed where it does the most good. The action of the device is such that the instant the guns stop firing, the inner cylinder immediately sinks into the outer one, thus disappearing from view. It goes without saying that these automatons cannot only be used to pump bullets into the oncoming enemy, but they can be used as well for other purposes—such as to belch forth liquid fire or to let loose a gas attack as depicted in our cover illustration. Perhaps it would not be a bad idea to equip every sixth automatic soldier with a poison gas tank, all of which will certainly tend to stop the most gallant as well as vicious attack of the enemy.

While machines of this kind seem very cumbersome, and perhaps not efficient, because it may be argued that they cannot think, nevertheless they would often be very much more valuable than the average soldier. For one thing, the machine knows no morale—it never retreats. It is not much affected by rifle bullets, and only a direct shell hit during a barrage will put the automaton *hors de combat*.

The automatic soldier is not dependent upon the rear for victuals, as the only thing it eats is munitions with which it can be supplied at night by way of the trenches. It is not affected by shell shock nor mustard gas, and liquid fire has no effect upon it. It never surrenders and never turns traitor. In order to be overcome, the automatics must be destroyed one by one, possibly only by exploding large quantities of T.N.T. against its sides. As long as the ammunition lasts no soldier would care to approach it, as he would never know when the wireless would set it off, which would immediately bring the automaton into action, no doubt killing the attacker.

It is difficult to see how ordinary infantry could overcome these automatics if planted three or four lines deep. Each trench line would have to be won at tremendous odds, and there is not a soldier living who would stand up under the withering fire of such automatons who know no fear.

A device of this kind is, of course, not chimeric, but entirely within the realms of present day science, and we would be very much surprised, indeed, if the automatics would not make their appearance soon at strategical points along the front. Nor are they difficult or expensive in construction, each one of the automatons not necessarily costing more than five or six thousand dollars, which is but the price of a modern torpedo. The wireless apparatus does not take up much room, while the motors which drive the entire mechanism may be readily operated by a 24-volt storage battery placed at the bottom of the large cylinder. All the rest of the mechanism is readily worked by comprest air which can be replenished easily at night after the automatics have gone into action during the day. This is the case also of ammunition, gas or chemicals for liquid fire, all of which can be replenished during the night time by men walking up to the machine thru lateral trenches.

Of course if there was no action during the day, there would be no need for replenishing anything.

It should also be understood that these automatics can be operated singly or in groups by means of electric cables buried into the trenches, if it is preferable to use this method instead of the not always so reliable wireless.

HISTORY OF THE RELAY WHEN "HUN" MET "YANK."

There is a curious fact connected with the history of the telegraph relay. It could not be patented in Germany, and therefore could not with safety be exposed. In 1848 two young Americans named Charles Robinson and Charles L. Chapin had gone there with Morse apparatus to try their fortunes in building lines. Wheatstone had a dial instrument in use on a short railroad line, but its action was feeble and unsatisfactory. Robinson and Chapin built a line of telegraph from Hamburg to Cuxhaven, a distance of ninety miles, by which to transmit marine news. The magnets, however, were carefully locked up in boxes, just as Alfred Vail did in Washington and Philadelphia. The line worked well. The registers clicked out loud and strong at either end. The German electricians scratched their heads and wondered. Finally, Steinheil was sent to make observations. He was a man of genius and culture and had a sort of telegraph at work in Europe before Morse in America. He looked carefully around, and his keen eyes soon saw the locked boxes. He asked to see their contents. But the view was courteously declined. So he turned and complained that the Yankees kept their secret locked, but that the action was magnificent. When, however, at a later date, he did finally know all, he gave Morse his hand, confest himself beaten, and the two were friends forever after.

HAS ANYBODY HERE SEEN S-P-E-R-R-Y??

Would you believe that "Sperry" was your good old friend the EXPERIMENTER in a new dress? Of course you wouldn't! But then you see it is like this: All is not gold that glitters and everything does not read as it sounds, hence we have EkSPERRYmenter! In other words, "SPERRY" is a new nickname for your good old friend "EXPERIMENTER". Now we admit that in our dull way of thinking, we never had an idea like it, and it had to come all the way from Malvern, which lies in sunny Australia, to put us wise to it. It also appears that the nickname for the "EXPERIMENTER" is "Sperry" in Australia. If you don't believe it, read the following:

Editor, ELECTRICAL EXPERIMENTER:

I have been reading the ELECTRICAL EXPERIMENTER now, for about two years, and I think it is absolutely the finest magazine on Electricity and Wireless. Long Life to *"Sperry"* as it is called out here. I notice that it is going up in price (for Australia) with the next issue. Well, I'm sure I (and anybody else) don't mind paying double the price that it is going up to, I am, sir.

Yours truly,
(Signed) S. ROBINSON,
87 Dandenong Road,
Malvern, Australia.

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THE AUTOMATIC WIRELESS SOLDIER

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The Latest Brilliantly Conceived and Patented Military Weapon is the Bullet-proof "Automatic Soldier." Loaded Up With Triple Machine Guns For Shooting Bullets, Liquid Fire and "Gas," and Finally—Controlled By Radio From a Bomb-proof Dugout—This Death-Dealing Invention Promises to Revolutionize Modern Warfare on Land.

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Why Not Electricity from the Ocean?

WHILE all of the vast resources of the country are being combed and recombed by the various experts connected with the National Government in order to produce the greatest output of war materials at the most economical cost, and also to conserve the great resources of the nation to the highest possible degree, a stupendous amount of power is daily and hourly going to waste, viz., that hydro-electric power which is not being developed as yet.

The rivers, lakes and waterfalls of the country represent a source of energy sufficient to care for a large proportion of all the needs required for our industrial and social life, if they could be harnest and applied to our requirements in an efficient manner; some of these waterpower developments, however, would prove uneconomical owing to the high initial cost in harnessing them to our needs.

Waterpower is not, however, confined to rivers, lakes and waterfalls, but there is constantly millions of horsepower going to waste in the action of the *ocean waves* along our sea-coasts of which we have several thousand miles on the Atlantic and Pacific seaboards. With the idea in mind of utilizing the gigantic power inherent in this constant wave motion which perpetually rolls up on our beaches day after day, year in and year out, a Yankee inventor, Mr. E. T. Stodder of New Rochelle, N. Y., has given a large amount of his time to the study of *wave motors* and devices intended to turn to industrial uses the great power which they possess. His invention is shown in the illustrations herewith.

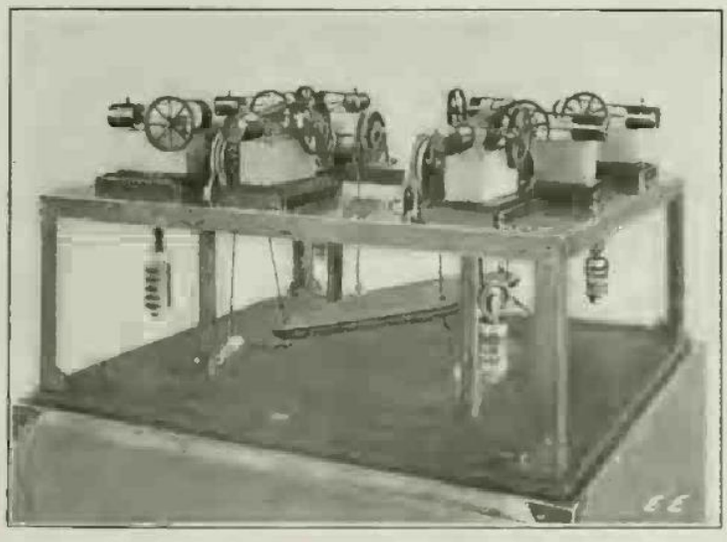
The larger view shows how Mr. Stodder's *wave motor* would be installed in a manner which much resembles one of the large steel piers to be found at any of our seashore resorts. The basic idea of this wave motor involves the utilization of the powerful lifting force exerted by the waves as they rise and fall, and to this end the inventor proposes the used of large steel float members, each float in a commercial sized machine to measure about eighty feet square, thus giving an area on which the wave can exert a lifting action, of 6,400 square feet, while a number of these floats can be placed along the pier as our illustration shows. At each end of these steel float members, which are airtight of course, there are two steel cables which lead upward to specially devised air compressors, so that no matter in which direction the float rises or falls, efficient work is performed by each and every movement of the float.

All of the comprest air generators connected with the cables from the floats, are connected with a main pipe line, and this in turn feeds a comprest air motor connected with an electric dynamo. The dynamo produces electrical energy which can be fed into storage batteries, and also to the wires supplying electric lights, etc. The smaller illustration shows a perfect model of this unique wave power plant built by Mr. Stodder, and in which the float member is shown suspended by the upper and lower end cables aforementioned, each cable being connected by suitable pulleys and balance weights to its own air compressor; which in this case was a small steam engine. As becomes evident, the inventor has used eight of these engines, and the model demonstrates very effectively the correctness of his theory and ideas along this line.

There are several very good features as disclosed by Mr. Stodder, and among others we find the following: By extending the pier out into the ocean, as the illustration shows, and by having a successive series of floats arranged along the pier, use is made of each wave as it progressively rises and falls in its motion toward the shore, and thus a steady stream of comprest air is kept flowing thru the pipe line to the pneumatic motors and dynamos. Owing to the fact that while one float may be all the way down or part of the way up, another one may be two-thirds the way up to the limit of its motion, etc. By looking at the various positions of the successive floats in the illustration, this feature will be more clearly understood. The invention seems to be better in this respect than those designed to be installed in any one spot, and which are intended to absorb the energy from the waves as they pass that spot. In such a case it is evident that as the wave recedes from the side of the wave motor, then practically no power is given to the floats or other devices which may have been provided. Also, in one wave power turbine devised for the purpose, the receding waves could not clear the blades efficiently.

(*Continued on page* 413)

The Latest Idea in Wave Motors—It Comprises an Extended Series of Buoyant Tanks or "Floats," Each Float Rising and Falling with the Waves and Serving to Compress Air. The Comprest Air Drives a Pneumatic Motor Connected to a Dynamo, Thus Producing Free Electricity From the Ocean Waves.



Model of New Wave Motor Built by Its Inventor, and Demonstrating How Each "Float" Operates Alternately Eight Air Compressors, Thus Utilizing Effectively Every Motion of the "Float."

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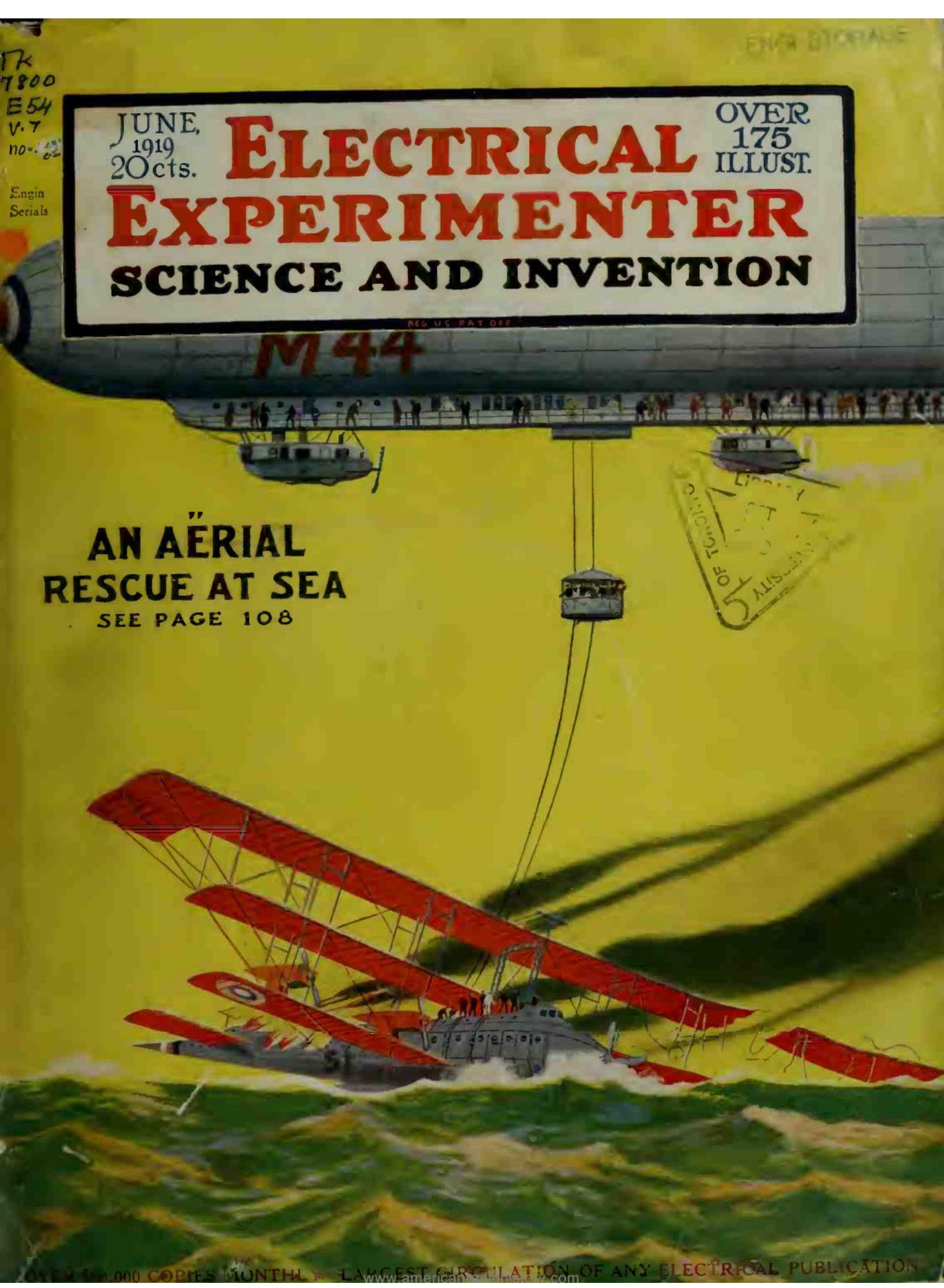

AN AERIAL RESCUE AT SEA

SEE PAGE 108

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Recent Aërial Developments

By H. GERNSBACK

In England They Have Already Mooring Towers Used to Take On and Put Off Passengers and Freight, It Having Been Proved That It Is Easier for an Airship to Anchor at a Lofty Height Than to Come Down and Dive Into a Shed. This Illustration Shows How the Woolworth Building or Any Other Building Could Be Equipt With a Revolving Landing Tower, to Which the Airship Can Make Fast. Passengers and Freight Can Then Be Readily Landed. A Project of This Kind Is Entirely Feasible From an Engineering Standpoint.

WHEN the Zeppelin, that is, the rigid type of airship, first appeared it had many inherent faults. Probably the greatest one was the inflammable gas carried in the sectional ballonets.

As fast as the Zeppelins were constructed they were destroyed mostly by fire due to electric sparks, which set on fire the inflammable hydrogen gas.

Secondly, the landing arrangements as used by the Germans were very inefficient, and it was not infrequent that the huge airship became wrecked when coming down to earth prior to entering its mooring shed. In the air, the Zeppelin type is safe enough, and even the severest storms can be ridden out with comparative safety, that is, all storms except electrical storms, which not infrequently set the dirigibles on fire, due to lightning.

Recently, the English have proposed a novel manner for landing passengers, and no longer do the huge airships of the rigid type descend to earth to discharge their passengers or cargo. The device used is a sort of huge hitching post in the form of a high tower held fast by means of cables and stays. The upper part of the tower has a revolving top section with which the nose of the airship comes into contact, and to this it is made fast. The passengers and cargo leave and enter by means of this revolving top and descend or ascend to earth by means of elevators. These towers are anywhere from three to five hundred feet high, and the airship can "land" and make fast to the tower with comparative safety, as has been actually demonstrated in England.

It makes no difference which way the wind blows or how hard, the airship will simply take its position, similar to a wind vane, where it offers the least resistance to the wind. It will ride out the most severe storm very readily in such a position and in comparative safety. This also has been actually demonstrated.

The fire danger is now being reduced entirely by the use of an American idea, helium gas, which has approximately the same lifting power as hydrogen, but which is absolutely non-inflammable.

It does seem that for many years to come the rigid type of airship will probably be the one destined to carry passengers and freight, while for a long time, the airplane will only act as a secondary unit, or as a feeder. In other words, the airship will be used to cover long distances, while the airplane will cover short distances, bringing passengers and freight to the central dirigible depots.

We have today airships with a capacity of 2,000,000 cubic feet of gas, and it will not be long until the 5,000,000 cubic foot gas dirigible will be in use. Aviation authorities think that such airships will be in operation not later than 1923.

When it is considered that the huge present-day English airships have a capacity of 2,000,000 cubic feet of gas, and which can now cover a radius of 4,000 miles without coming down to earth or renewing their supplies, it will be seen that universal aërial transportation is a feature much closer at hand than is realized by most of us.

There is little doubt that before this year has ended one or more dirigibles will have crost the Atlantic Ocean. Flying at their present rate of speed, which is sixty miles per hour, it will be seen that the trip from London to New York will take only 2 to 2½ days. The huge 5,000,000 cubic feet of gas airships will probably fly at the rate of 100 miles per hour. The length of the trip will then be cut down to about 1½ days.

While the aërial tower which we discuss above is probably satisfactory, it has many objections, the most important one being that it is an expensive item, and, moreover, if the airship is to rely upon such a structure, it will be almost impossible for it to come down to earth to land passengers *except at such points where the mooring towers are located.* This is a clear disadvantage.

In the accompanying illustration the writer wishes to advance an idea which so far has not been tried out, but which can be readily adapted. The idea is simply to moor the dirigible by means of four cables, which are thrown from the aërial flier. The passengers then will be able to ascend or descend from the airship by means of light elevators operated between the dirigible and earth. These elevators, electrically operated, need not be very heavy and can be constructed of aluminum, duralumin, or some such material. The power to operate these elevators can be taken from the engines of the dirigible itself, and it will be quite an easy matter to take from fifteen to twenty passengers on a single trip.

Our illustration shows the city of London, in the year 1925, with one of these dirigibles made fast to the aërial depot; we see here two elevators operating and taking on passengers and freight. The air-

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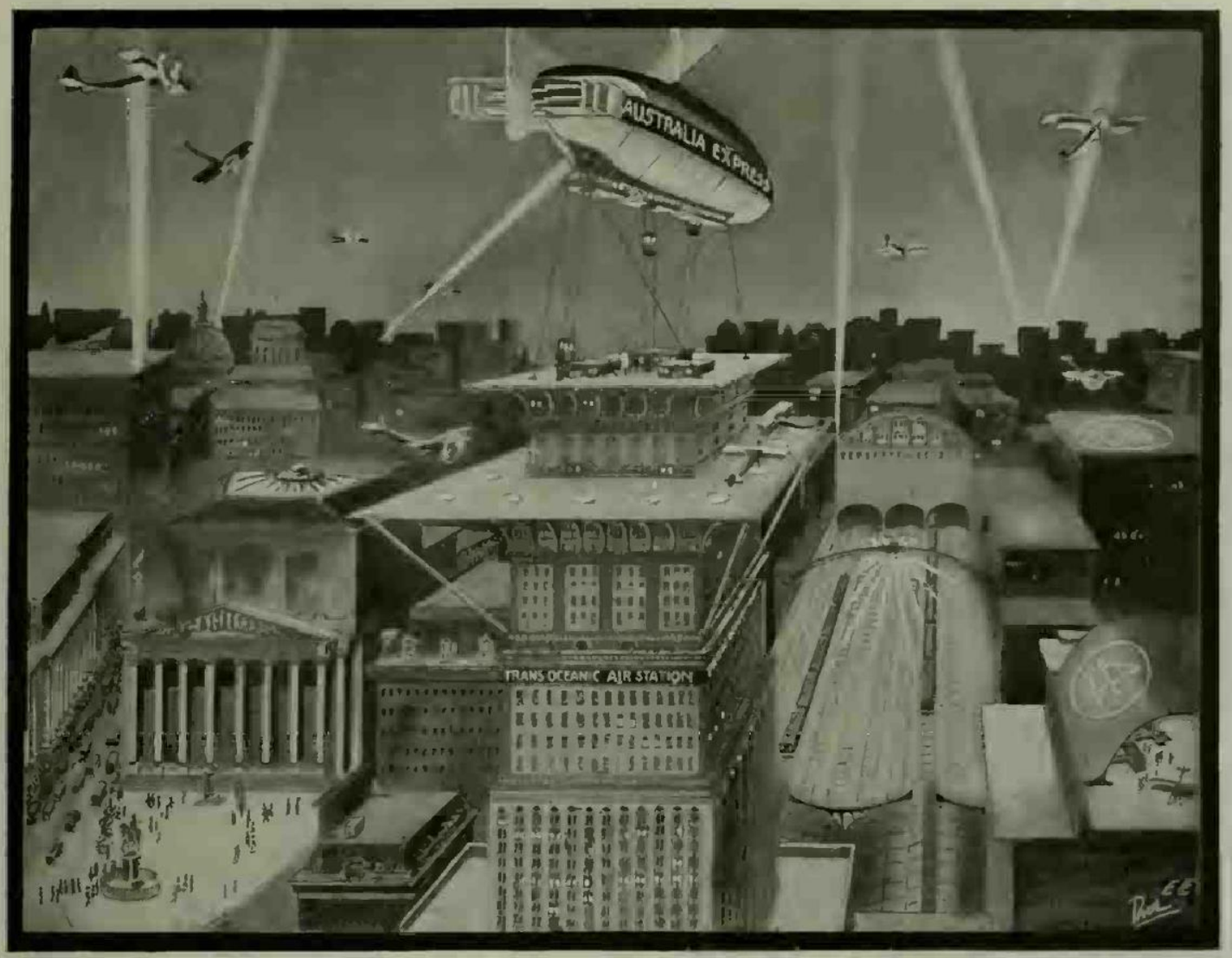

The Heart of London as It Will Appear Very Shortly When the Plans Now Undergoing Completion Are Realized. It Having Been Demonstrated That It Is Very Difficult to Bring Down the Huge Airships to the Ground—Many Zeppelins Having Been Wrecked That Way—It Has Been Proposed to "Land" Airships on Top of Specially Elevated Stations as Here Shown. The Airship would Be Simply Anchored by Means of Four or More Steel Cables. Then, by Using a Number of Light Elevators or Lifts, the Passengers as Well as Freight Can Be Taken on or Put off, as Our Illustration Clearly Depicts. This Is Not a Dream of Tomorrow, but Plans Are Actually Under Way to Make This Feature a Realization. It will Be Seen That the Airplanes Merely Act as a Sort of "Feeder" and They Will Be Used Mostly to Bring Their Passengers or Freight to the Trans-Atlantic Landing Station.

ship shown belongs to the regular trans-Atlantic Service and makes the trip between London and Perth, Australia in 4½ days. Should it become necessary to discharge or take on freight at non-important centers, it will be a simple matter to moor the airship by means of its cables even over a city which has no elaborate landing station. Nothing but four points to which to make the cables fast are required. The elevators which are carried by the airship will do the rest.

Our cover illustration shows a spectacular method of an aërial rescue at sea, which immediately demonstrates the practical use of these elevators. Indeed, the airship does not need to make fast to the wrecked airplane; it will keep its position simply by running either one or more of its propellers in order to keep from drifting. This is quite simple even for the present-day airship, as it is possible by means of its propellers to hover over a certain spot even with a strong wind blowing. In this case, the elevator cables only are made fast to the wrecked flyer, the gasoline tanks of which have been set on fire. After the elevator cables are made fast, it will be a comparatively simple matter to take off the passengers, and, if necessary, the freight, for the buoyancy of the airplane in the water will probably keep it afloat for some time. After everybody is taken off, the elevator is hoisted, the elevator cables pulled in, while the airship proceeds on its way.

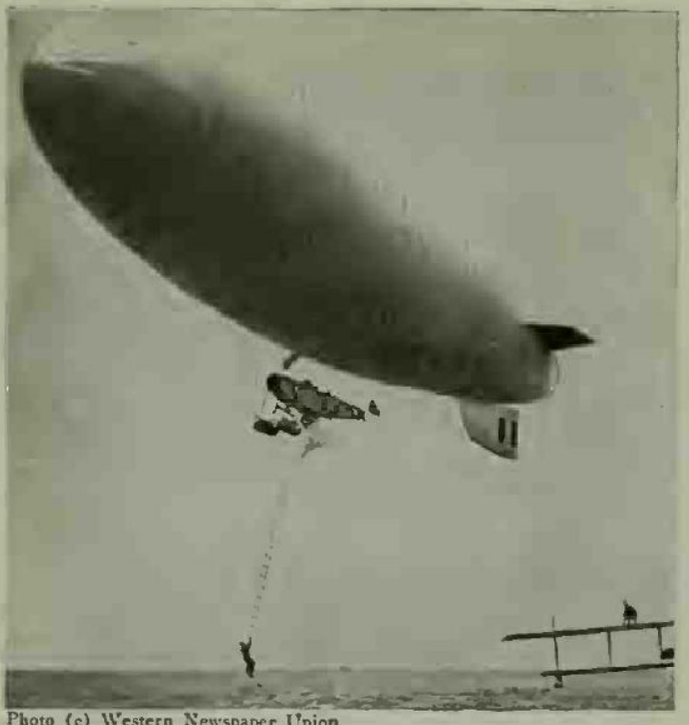

Photo (c) Western Newspaper Union

This Remarkable Snapshot Shows One of Our Navy's Dirigibles Rescuing Two Airmen Who Recently Fell Into the Sea with Their Flying Boat off Key West, Florida. One of the Aviators Can Be Seen Climbing up the Rope Ladder.

This spectacular rescue might seem to be a thing of the future, but indeed it is not. Our photograph herewith shows that the very same thing has already been accomplisht on a smaller scale. Very recently the United States Navy equipt its dirigibles with rope ladders, which made it possible to rescue aviators from the sea. That such a move was indeed wise, our photograph demonstrates better than words. Our remarkable snapshot shows one of the Navy's "blimps" rescuing two airmen who recently fell into the sea with their flying boat off Key West, Fla. The nose of the airship was simply turned into the wind, and after some maneuvering it finally managed to get directly over the disabled flyer. The two marooned airmen experienced no difficulty in grasping the rope ladder and climbing aboard the airship, none the worse for their adventure.

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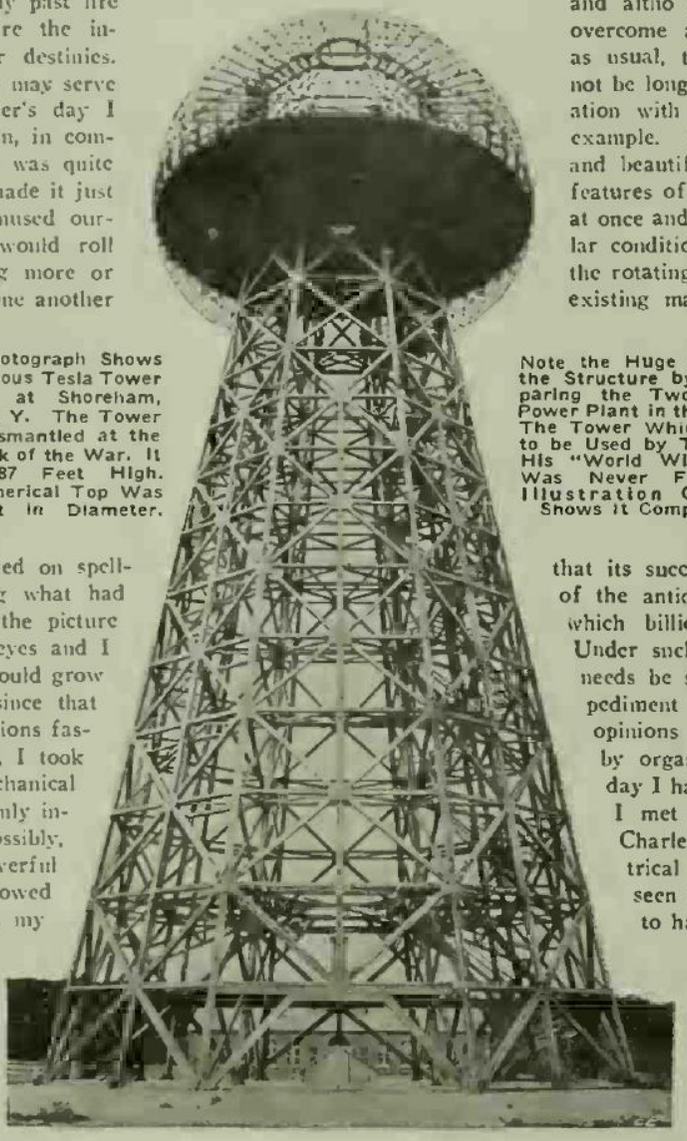
My Inventions

By Nikola Tesla

V. The Magnifying Transmitter

AS I review the events of my past life I realize how subtle are the influences that shape our destinies. An incident of my youth may serve to illustrate. One winter's day I managed to climb a steep mountain, in company with other boys. The snow was quite deep and a warm southerly wind made it just suitable for our purpose. We amused ourselves by throwing balls which would roll down a certain distance, gathering more or less snow, and we tried to outdo one another in this exciting sport. Suddenly a ball was seen to go beyond the limit, swelling to enormous proportions until it became as big as a house and plunged thundering into the valley below with a force that made the ground tremble. I looked on spellbound, incapable of understanding what had happened. For weeks afterward the picture of the avalanche was before my eyes and I wondered how anything so small could grow to such an immense size. Ever since that time the magnification of feeble actions fascinated me, and when, years later, I took up the experimental study of mechanical and electrical resonance, I was keenly interested from the very start. Possibly, had it not been for that early powerful impression, I might not have followed up the little spark I obtained with my coil and never developed my best invention, the true history of which I will tell here for the first time.



This Photograph Shows the Famous Tesla Tower Erected at Shoreham, L. I., N. Y. The Tower Was Dismantled at the Outbreak of the War. It Was 187 Feet High. The Spherical Top Was 68 Feet in Diameter.

Note the Huge Size of the Structure by Comparing the Two-story Power Plant in the Rear. The Tower Which Was to be Used by Tesla in His "World Wireless," Was Never Finished. Illustration Opposite Shows it Completed.

Scrapping the World's Engines.

"Lionhunters" have often asked me which of my discoveries I prize most. This depends on the point of view. Not a few technical men, very able in their special departments, but dominated by a pedantic spirit and near-sighted, have asserted that excepting the induction motor I have given to the world little of practical use. This is a grievous mistake. A new idea must not be judged by its immediate results. My alternating system of power transmission came at a psychological moment, as a long-sought answer to pressing industrial questions, and altho considerable resistance had to be overcome and opposing interests reconciled, as usual, the commercial introduction could not be long delayed. Now, compare this situation with that confronting my turbine, for example. One should think that so simple and beautiful an invention, possessing many features of an ideal motor, should be adopted at once and, undoubtedly, it would under similar conditions. But the prospective effect of the rotating field was not to render worthless existing machinery; on the contrary, it was to give it additional value. The system lent itself to new enterprise as well as to improvement of the old. My turbine is an advance of a character entirely different. It is a radical departure in the sense that its success would mean the abandonment of the antiquated types of prime movers on which billions of dollars have been spent. Under such circumstances the progress must needs be slow and perhaps the greatest impediment is encountered in the prejudicial opinions created in the minds of experts by organized opposition. Only the other day I had a disheartening experience when I met my friend and former assistant, Charles F. Scott, now professor of Electrical Engineering at Yale. I had not seen him for a long time and was glad to have an opportunity for a little chat at my office. Our conversation naturally enough drifted on my turbine and I became heated to a high degree. "Scott," I exclaimed, carried away by the vision of a glorious future, "my turbine will scrap all the heat-engines in the world." Scott stroked his chin and looked away thoughtfully, as though making a mental calculation. "That will make quite a pile of scrap," he said, and left without another word!

IMAGINE a man a century ago, bold enough to design and actually build a huge tower with which to transmit the human voice, music, pictures, press news and even power, thru the earth to any distance whatever without wires! He probably would have been hung or burnt at the stake. So when Tesla built his famous tower on Long Island he was a hundred years ahead of his time. And foolish ridicule by our latter day arm-chair "savants," does not in the least mar Tesla's greatness.

The titanic brain of Tesla has hardly produced a more amazing wonder than this "magnifying transmitter." Contrary to popular belief his tower was not built to radiate Hertzian waves into the ether. Tesla's system sends out thousands of horsepower thru the earth—he has shown experimentally how power can be sent without wires over distances from a central point. Nor is there any mystery about it how he accomplishes the result. His historic U. S. patents and articles describe the method used. Tesla's Magnifying Transmitter is truly a modern lamp of Aladdin.

EDITOR.

"Aladdin's Lamp".

These and other inventions of mine, however, were nothing more than steps forward in certain directions. In evolving them I simply followed the inborn instinct to improve the present devices without

(*Continued on page* 148)

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Mr. Tesla's articles started in our February issue

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THIS PHOTOGRAPH OF A MODEL SHOWS HOW THE TESLA TOWER BUILT ON LONG ISLAND, EIGHTEEN YEARS AGO, WOULD HAVE LOOKED COMPLETED. FROM ITS APPEARANCE NOBODY WOULD INFER THAT IT WAS TO BE USED FOR THE GREAT PURPOSES WHICH ARE SET FORTH IN HIS ACCOMPANYING ARTICLE.

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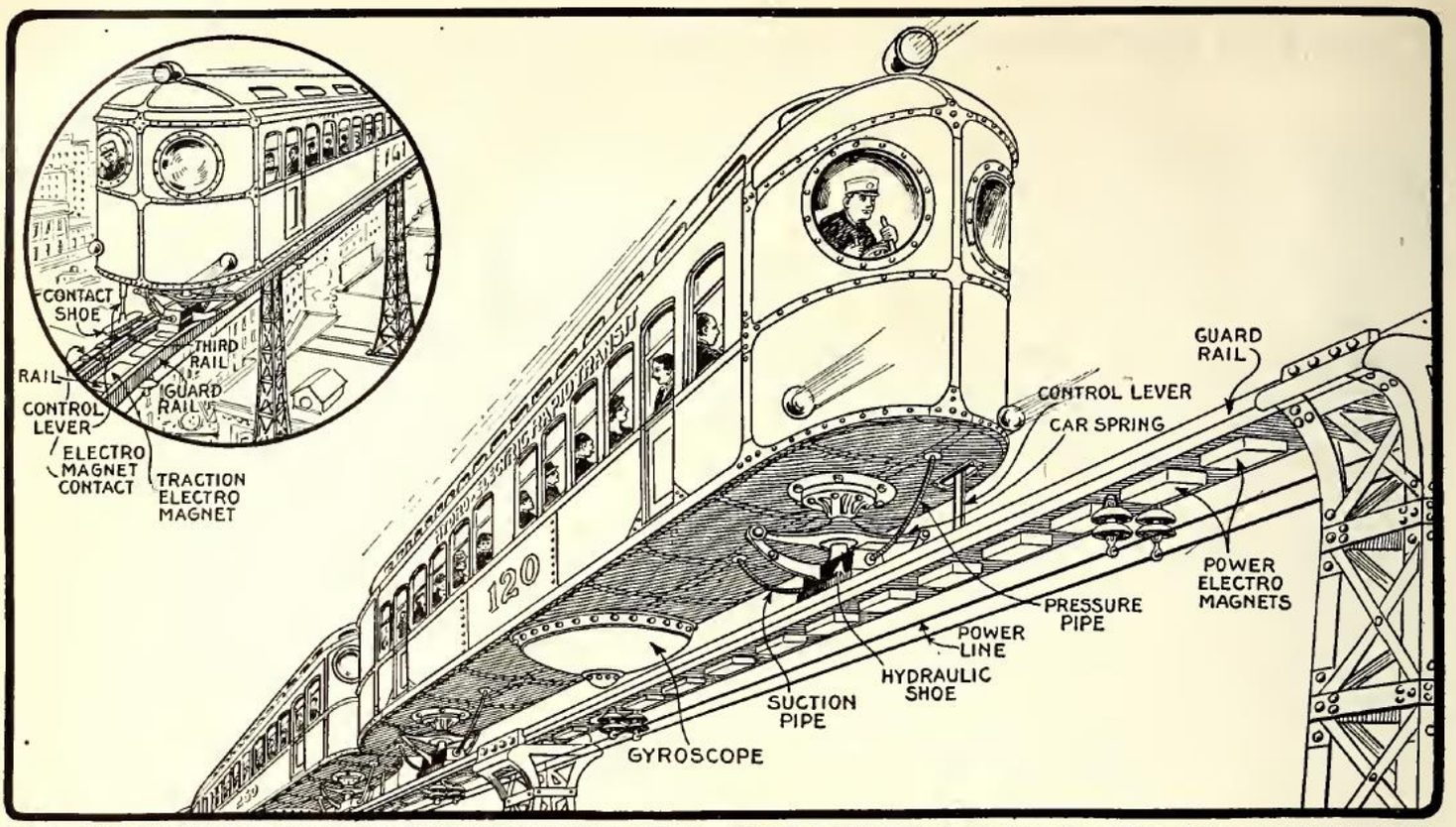

Fig. 5. This Illustrates the Propulsion of the Wheelless Gliding Train. The Two Hydraulic Shoes Glide On a Film of Comprest Water Squirting from Underneath the Shoes. The water Is Recovered by Suction from the Same Shoe So None is Lost. (See Fig. 3.) The Train Itself is Kept Upright On a Single Track by Means of a Gyroscope, While the Cars Are Propelled by Powerful Electro-magnets, the Contacts of Which Are Closed Automatically by the Train as It Moves Along. These Gliding Railroads, Having No Friction, Work So Easily that a Child Can Push Along a Car With Its Passengers.

Solving the Transportation Problem

By H. GERNSBACK

A Railway Which Actually Existed In France

THIS is the story of a most extraordinary railway which at one time existed in France. Its inventor was killed by the invading Germans in 1870. A railroad that is practical and which has demonstrated its successful operation. It is practically frictionless and can move SAFELY with a speed of one hundred miles an hour. It will be in use thruout the world.

SINCE the advent of the steam locomotive in the early 50's of the last Century, no progress whatsoever has been made as far as speed of our railways is concerned. We are today not riding faster either in our electric or steam railways than our grandfathers did 60 years ago. It is true that we have greatly improved everything else as far as comfort, safety, etc. is concerned, but the speed has not been increased whatsoever. Sixty miles an hour was an everyday occurrence sixty years ago, and was attained by many trains. Today, the average speed of the steam or electrical railways does not approach more than 50 miles.

Present Disgraceful Conditions.

What are we to do? In our big cities we are running street-cars on the surface, trains on elevated railroads and down in the subways. The more roads we build, the more acute becomes the shortage of transportation as far as passengers are concerned, and in any big city transportation facilities are always woefully behind the actual demand. In the morning everyone goes to business about the same time and in the evening everyone must ride home—our so-called rush-hours. The density of travel thus become enormous, particularly in cities like New York or Chicago, where conditions, as is well known, are intolerable, and in many cities, disgraceful. If it were possible to operate our railroads with safety only two or three times as fast as they are running now, it stands to reason that everybody would have a seat, an impossible condition now.

We cannot run our trains faster than they run now without encouraging accidents such as collisions, derailments, etc. As far as the present day railroad is concerned, it is not possible to increase its speed at all. There is, however, one solution, an invention which dates back to 1852. we refer to the *Gliding Railroad* which actually had been tried in France, and had been perfected in a small way. At that time, however, many technical obstacles made the project impossible, but all of these objections have now been overcome by new inventions and methods which we will discuss more fully.

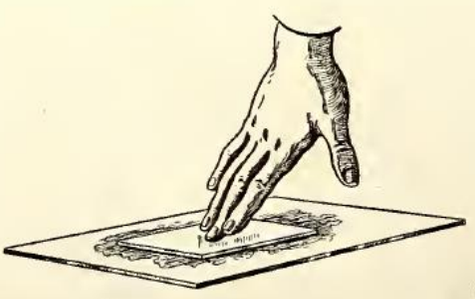

Fig. 1. The Principle of the Gliding Railway. Two Glass Plates Are Dipt Into Water. The Upper Plate Will Glide With Astonishing Ease. The Two Plates Do Not Touch. A Thin Water Film Separates Them.

Principle of Gliding Railroads.

Let us turn to Fig. 1 which gives us the principle of the gliding railroad. Take two smooth pieces of glass, such as are used for photographic plates. Boil them in water, until the gelatin comes off and clean thoroly. Use one large plate and one small plate as shown in illustration. Dip the two plates into water, and place the small plate on top of the larger. It will be seen that the small plate will *glide* with remarkable ease over the large plate. The important thing to note is that *the two plates do not touch.* They are supported by a thin film of water, *hence the top plate glides on an exceedingly thin water film.* As we move the plates back and forth we squeeze out the water little by little, and as soon as the plates touch, the free movement will stop. Were we to drill a hole in the top plate and attach a small tube to it containing water under pressure, we could then for a long time move the plate back and forward with very considerable ease; we would then always maintain a good water film on which our top plate could glide.

Exactly this is the principle of the gliding railroads, first invented by L. D. Girard, a great French engineer. Already in 1852 M. Girard proposed to replace the ordinary railways by means of hydraulic propulsion. He was quite successful with

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his first models and in 1854 he conceived the idea to replace the wheels by means of *hydraulic skates* gliding over flat rails. By means of this method, he did away entirely with all friction for the reason that *he interposed between the skate and the track a film of water under pressure.* At first M. Girard was using comprest air, but he found that it was necessary to use water under pressure because air did not give satisfactory results.

Railroad was Actually in Use.

He actually constructed on his property de la Jonchère, near Paris, such a wheelless railroad which had no locomotive, the cars of the train gliding on a film of water. The propulsion of the train itself was affected by a sort of turbine arrangement whereby a stationary water jet was hurled against stationary vanes mounted under the cars. In other words, the train acted as the stationary part of a turbine, while water jets placed alongside the road, and operating automatically, pushed the train along. This railroad worked very well and actually transported passengers in a limited degree. In 1869 M. Girard obtained a concession from the French Government to run a wheelless railroad line from Paris to Argenteuil. Unfortunately, the Franco-Prussian War in 1870 then broke out and his experimental railroad at de la Jonchère was ruined by the Germans and Girard himself was killed. Nevertheless, the principle had been proven sound by actual practise. There is no reason why with modern methods and improvements it cannot be made a huge success.

In our Fig. 2 is shown one of Girard's hydraulic skates or shoes and its operation. M. Girard's train had two *flat* rails, and each car had four hydraulic skates or shoes which replaced the usual wheels. Fig. 2 shows three views of the shoe. It will be noted that water pressure is supplied to the shoe which fills the interior fully. As soon as the pressure becomes high enough, it is obvious that the water must escape by raising the shoe clear from the rail, providing enough pressure is used. While the water escapes, it will be readily understood that the shoe itself can nowhere touch the rail proper. In other words, *the shoe floats on a thin film of water.* If no other means were provided, it can be seen that an enormous quantity of water would be needed to supply the hydraulic shoes, while the train was moving, or even standing still. The water would squirt out incessantly.

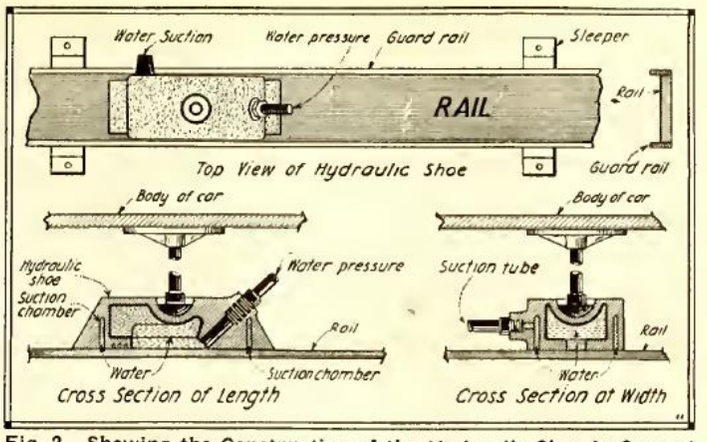

Fig. 2. Showing the Construction of the Hydraulic Shoe in Several Views. The Water Is Pumped Into the Shoe Under High Pressure. As the Water Leaves the Shoe, It Is Sucked Back Thru the Suction Chambers. The Hydraulic Shoe Cannot Leave the Track On Account of the Guard Rails. (See Upper Right Hand Detail Sketch.)

No Water Is Lost.

However, another French engineer, M. Barre had the happy idea to recover nearly all the water, and this arrangement is also shown in Fig. 2. Running near the edge of the hydraulic shoe will be found an annular suction chamber which is connected to a suction tube. It will be realized that as quickly as the water is prest out from under the shoe, it must pass the suction chamber, *and here it is sucked back to the water reservoir* of the train to be used all over again. With this ingenious arrangement, it will be readily seen that practically no water is lost except a minute quantity used in wetting the rail, and this loss per train amounts to only a gallon or two per mile, even for a heavy train.

A very important, and as a matter of fact, the most important part of this railway is, that as the cars glide on water they *can be made to run with marvelous ease.*

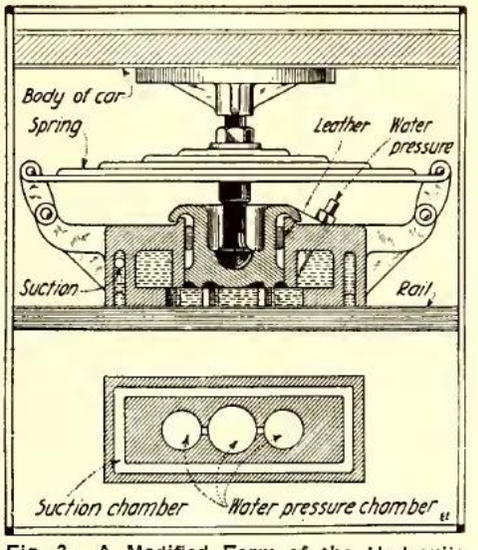

Fig. 3. A Modified Form of the Hydraulic Shoe. It Works Similarly to the One In Fig. 2. Note the Piston Arrangement Which Gives the Train a Feathering, Cushion Effect.

Child Can Pull Train.

M. Girard already demonstrated that *a six year old child could move a standard railway car* rapidly over a track, so easily does such a railway operate. The reason is of course that no metal of the train touches the track, therefore nearly all friction is suppressed. By actual experiments it has been shown that M. Girard's cars could be moved with a weight *one half of one thousandth of the weight of the car.* In other words, a railroad car weighing several tons can be pushed along rapidly with an expenditure of a few pounds of energy. The water film itself is of course exceedingly thin, measuring only from one-half to three-quarters of a millimeter. In other words, not much thicker than six sheets of paper on which this story is printed. Nor was the water pressure as high as one might think at first:—10 lbs. per square centimeter.

M. Girard found his greatest trouble in two points. First, he had trouble with his rails at the point where the latter connected. It is of course necessary that a railway of this kind should have an exceedingly smooth metal rail which must not have any uneveness whatsoever. Also where the rails join, it was found necessary to interpose pieces of leather or soft rubber, otherwise the water would squirt out between the rails. Of course, we would not have this difficulty today because we would simply weld the rails together, making them a uniform piece of metal. This source of trouble, and it was M. Girard's greatest one, would be unknown today. The other great difficulty was to propel the train.

How to Propel Wheelless Trains.

There was used in Paris at one time an arrangement as shown in Fig. 4. Inasmuch as no wheels are used, and because the hydraulic shoes have no tractive effect themselves, entirely new means must be provided to move the train. The old French idea is shown in this illustration where a rail rack was run all along between the (*Cont. on page* 336)

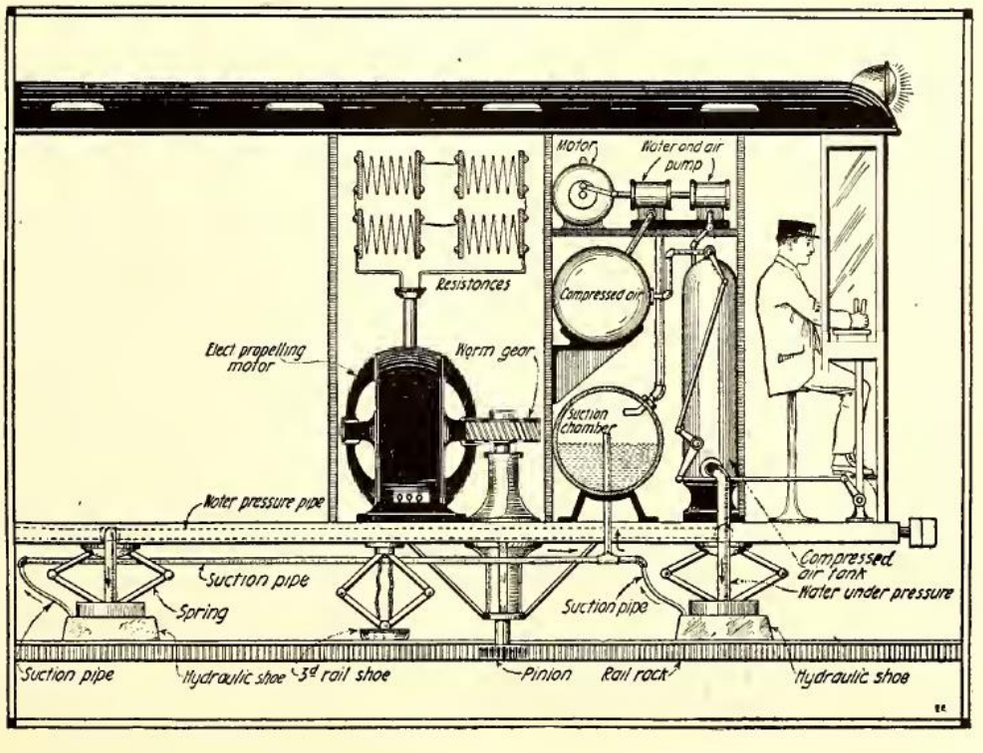

Fig. 4. Showing the Propulsion Used in the early French Gliding Wheelless Trains. A revolving Pinion Engages with a Rail Rack, Thus Pushing the Train Along. Illustration Also Shows the Method of Hydraulic Shoe with Comprest Water, and How the Lost Water Is Sucked Back.

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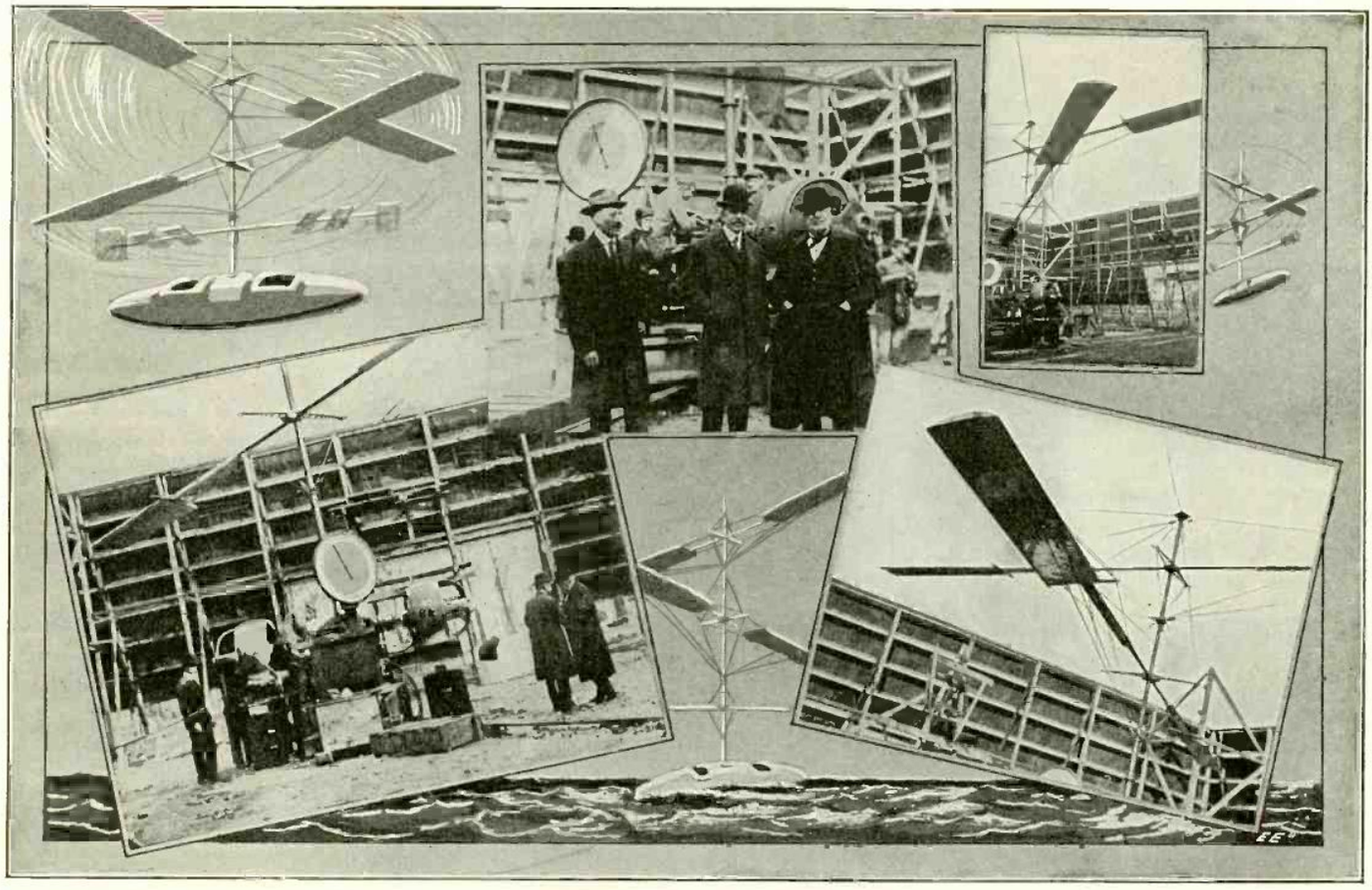


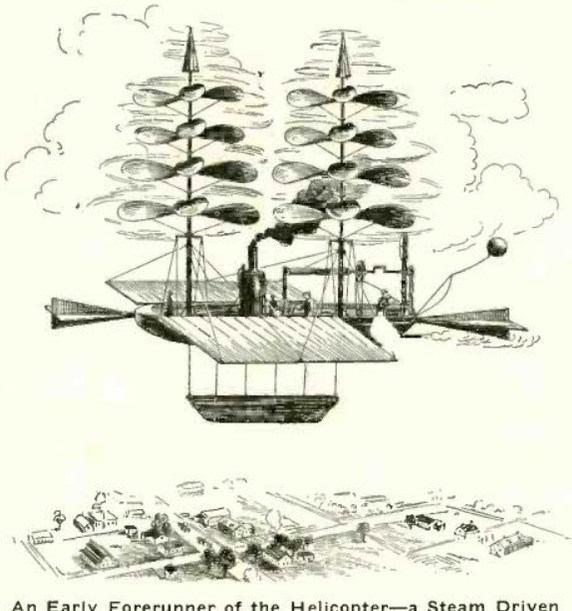
Top Right: Full Length View of Helicopter No. 1, Showing the Testing Installation of the Vital Features of the Machine. Lower Left: Showing the Temporary Installation of Two Electric Motors Each Capable of Developing a Maximum of 100 Horse-power. The Upper Gear Wheel of the Reducing Gear Is Seen Just Above the Box-Like Structure, Which Carries the Large Dial of the Platform Scales Used in Measuring the Lift or Thrust of the Propellers at Different Speeds and Power. The Motor Foundation Was Pivoted So That It Would Show Any Tendency of the Propellers to Turn the Whole Machine About Its Center. This Impulse Was Found to Be Practically Negligible, and the Entire Apparatus When Running at Maximum Trial Speed Could Be Rotated Freely to Right or Left by the Pressure of One's Hand. While Guys Were Attached to the Top of the Shafting to Steady the Machine, This Precaution Was Found Unnecessary, Because the Apparatus Stabilized Itself in a Pronounced Manner, the Faster the Screws Revolved. Lower Right: Details of the Propeller Blades, Guying and Shafting of Helicopter No. 1. Top Center Photo: Dr. Peter Cooper Hewitt in the Center. Thomas A. Edison, Who Is Interested in the "Helicopter," at Dr. Hewitt's Left and One of Dr. Hewitt's Technical Assistants to His Right.

The "Helicopter", A Vertical Airplane

By ROBERT G. SKERRETT

THE HELICOPTER has been an aeronautical puzzle ever since inventive genius tackled the problem of producing a heavier-than-air flying machine. Mechanical success of a sort has been realized from time to time by those variously engaged in this undertaking; but so far as the records show no full-sized craft of this type, with one exception, has been produced capable of lifting its designed full load. In short, they have been unable to rise as they stood. The one exception is the reason for being of the present article.

In an effort to strengthen our coast defense during the recent conflict, Doctor Peter Cooper Hewitt, who has given the world the most economical form of artificial light in his mercury vapor lamp, and Professor Francis Bacon Crocker, long the head of the Department of Electrical Engineering of Columbia University, combined their talents to bring to a practical head certain experiments with the helicopter initiated by Dr. Hewitt in 1906. They began their work in 1917, and a year ago brought their labors to a brilliant climax after they had put *Helicopter No.* 1 thru a series of exhaustive tests. The armistice was declared just as the ground trials were finished and *flight* was the next feature of the program. The cessation of hostilities caused a tremendous slump in aviation, and interest for the nonce in the helicopter lagged. Now, however work is about to be resumed, and both Dr. Hewitt and Prof. Crocker are positive in their assertions that the craft will do as well aloft, as it has done within its hangar at Ampere, New Jersey.



An Early Forerunner of the Helicopter—a Steam Driven Vertical Flier Proposed by Mr. de La Landelle in 1863.

The fundamental stumbling block heretofore has been a propeller capable of translating into effective thrust, or *lift*, a sufficient measure of the prime mover's developed power. None of them has in the past given, at useful working speeds, more than 10 pounds of thrust per unit of horse-power—most of the aviation propellers fall considerably below this in performance. The propellers evolved by Dr. Hewitt and Prof. Crocker have yielded more than 20 pounds of thrust per horse-power! These engineers have achieved this by breaking away from the generally accepted types of aeronautical screws both in the matters of size, design, and the materials employed. To be brief, they are adaptations of the aerofoil—the blades are relatively miniature airplane wings.

Without elaborating upon the physical circumstances under which the usual airplane propeller of relatively small diameter functions, it will suffice to mention that it revolves at a speed varying from 1,000 to 2,000 times a minute; it has a very large percentage

of slip; and its effectiveness is greatly reduced by the way in which it disturbs the air well ahead of it. This latter motion cuts down proportionally the screw's hold upon the atmosphere and its capacity to exert a propulsive effort. As the outer portions of a propeller's blade do most of the helpful work, it is evident that the hub and the massive inner sections of the blades are something of a handicap. Finally, owing to its moderate diameter, the ordinary airplane screw has only a modest volume of air to work upon.

In planning Helicopter No. 1, the first aim was to obtain propeller blades having high sustaining and propulsive factors, as the entire burden of lift and horizontal movement was to depend upon the screws. These were mounted upon concentric, tubular shafts, revolving oppositely. It was not enough to use aerofoil blades; it was quite as necessary *to have recourse to propellers of large diameter, driven at comparatively low angular velocities,* which would act upon a large mass of air without previously setting up discounting perturbations. To this end, each of the propellers of Helicopter No. 1 has a diameter of 51 feet, and the speed of revolution is about 100 turns a minute.

The blades are attached to tubular steel arms, and placed where the periferal speed will make most effective their length of 15 feet and their breadth of 2½ feet. The blades consist of a succession of transverse partitions or frames of aluminum over which is laid, top and bottom, a single sheathing of the same metal. To prevent "chattering" the blades are attached to the supporting arms forward of the center of pressure. Therefore, the blades are, in effect, drawn instead of being pushed thru the air. This arrangement gives the blades a certain measure of automatic adjustment of pitch when meeting with varying stresses and changing angles of travel on the part of the machine.

The vital features of Helicopter No. 1, as assembled for testing, weighed something less than 2,300 pounds. When the screws were turned at the rate of 70 revolutions a minute—their two electric motors then developing 126.5 horsepower—the total effective *lift* amounted to 2,550 pounds, i. e., *20.2 pounds of lift per horse-power!* Electric motors were used in place of aviation engines because they made it possible to carry on the tests progressively, from the lowest speeds upward, and to read off at the electric meters the actual power consumed at any moment. The driving apparatus between the motors and the shafts consists of an ingenious reducing gear by which it is feasible to step down the prime movers' speed from 1,400 to 100 revolutions a minute. This makes it practicable to employ the high-speed aviation engine and yet to obtain the desired low rotary movement of the propellers.

The reducing gear was developed by Dr. Hewitt, and, while possessing a measure of flexibility to meet the variable stresses of mechanical flight, is, nevertheless, positive in the contacts between the pinions of the engine shafts and the two geared wheels to which the upper and the lower tubular propeller shafts are, respectively, secured. Revolving oppositely, the propellers exert a very notable stabilizing moment; *and so marked is this effect that it was unnecessary to steady the machine by guys during the ground trials!* Furthermore, due to the fact that the screws neutralize one another, so far as they might tend to turn the engine platform about its center, it is at once evident that the helicopter will not spin about its own axis when aloft. Also, it will, for this reason, be easily steered by the rudders to be provided for that purpose. Dr. Hewitt has designed a double reducing gear which will operate at a ratio of 23 to 1. By means of the wide use of opposing forces, and the employment of antifrictional bearings, this engineer-scientist obtains a series of dynamic couples which neutralize one another and thus insure balanced action.

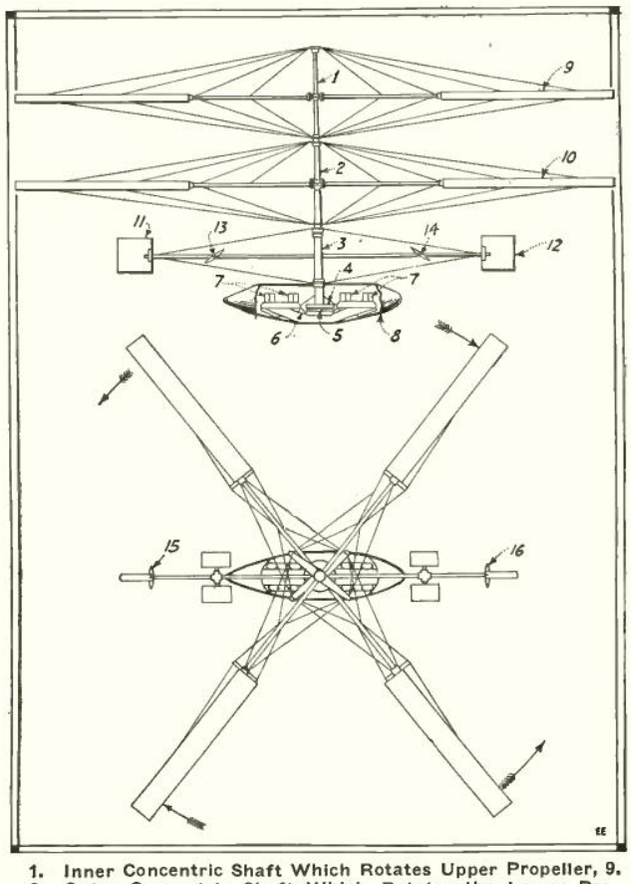
In all of its essentials, Helicopter No. 1 is a practical man-carrying machine, and can be made ready for flight by substituting two airplane engines in place of the testing electric motors. *It is only necessary to tip the machine a matter of about five degrees toward the bow or toward the stern, to propel it at high speed in either of these directions.* This tipping action is effected by suitable rudders; and when the helicopter has assumed the desired angle, a double set of vertical rudders, opposed to the line of advance, act against one another and hold the machine in that plane of motion. The helicopter will be able to hover aloft, and can be made to ascend or descend vertically with the utmost deliberateness. With half of the engine power "dead" the helicopter will return to earth at a safe speed. However, because of its high ratio of thrust per unit of power, it is feasible to equip an aircraft of this kind with a reserve motor which can be put in gear at the will of the pilot or automatically upon the failure of any of the working engines.

Professor Crocker has thus summarized the advantages of the present type of flying machine: "The helicopter will start from any moderate space such as a roof or ordinary street, and come back to land on the same spot. It is inherently stable and cannot dive, the support being all above and the weight below; so that special skill is not required to operate it at high or low speeds to prevent it from getting out of control. The helicopter is substantially *fireproof,* being constructed thruout of metal. To build it, no labor or materials that are difficult to obtain are needed. The craft can be constructed in an ordinary machine shop, and can be assembled, disassembled, or repaired with the skill and facilities commercially available. The helicopter is far less noisy than the airplane and, because of its general design and arrangement, less conspicuous when up in the sky."

As the editors see it this remarkable development in flying machines certainly looks like a long step in advance, if all of the many predicted qualities inherent in its design are fulfilled in actual flight. Especially in war-time will the marked advantages of this type of aircraft be apparent, for its visibility will be far less than that of the present airplane, which has wings of considerable area. Besides, the small wings or rerevolving screws of the Helicopter will prove a difficult target for the enemy gunners, whether aloft or on land. The cab of the Helicopter can be armored so as to readily withstand ordinary bullets and shell fragments. And just imagine the great superiority of an aerial observing station that can "hover" about, in one spot if need be, in order to gain an accurate sight on enemy artillery and other activities.

We have now considered some of the advantages of the Helicopter, but it would seem to the editors that there are also some disadvantages. For instance, owing to the small sustaining surface of the screws, which act virtually as wings also, what will happen if accidentally or in battle, the engines happen to fail? It would seem that the airship would obey the law of gravity and dart earthward at a rapid rate. Airplanes can volplane down safely if the engine stops, as their superior wing surface allows of their doing so; but perhaps the inventors of the Helicopter here shown have circumnavigated this problem in a manner which they have kept to themselves so far.

Those interested in trying out the merits of the Helicopter flying machine will find a most interesting article on a successful flying model of this type, by Mr. William J. Beach, in another part of this journal.



1. Inner Concentric Shaft Which Rotates Upper Propeller, 9.
2. Outer Concentric Shaft Which Rotates the Lower Propeller, 10.
3. Permanent Tubular Sleeve Which Takes the Weight of the Machine and Alternately Bears the Lift and Compression Loads When the Craft Is Flying or at Rest.
4. Upper Wheel of Reducing Gear.
5. Lower Wheel of Reducing Gear. The Geared Pinions on the Engine Shafts Are Introduced Between These Wheels and Drive Them Equally. The Shaft of the Lower Propeller Is Secured to the Upper Wheel and the Shaft of the Upper Propeller Is Attached to the Lower Gear.
6. Engine Foundation Structure.
7, 7. Aviation Motors.
8. Fuselage.
11 and 12. Rudders That Can Be Swung Both Horizontally and Tipped to the Right or Left from the Vertical. By Tipping Them Oppositely, the Down Draft from the Propellers Tends to Rotate the Fuselage So That the Craft Will Swing to Port or Starboard. By Tipping No. 11 So That the Rudder Face Is Vertical Instead of Horizontal the Machine Is Inclined by the Head and Will Then Advance Horizontally in that Direction. Similarly So Inclining No. 12 will Cause the Helicopter to Travel Rearward.
After the Craft Is Started Horizontally at Any Angle of Advance, the Rudders 13 and 14 Are Set Oppositely, Thus Forming a Dynamic Couple Which Tends to Hold the Machine Inclined and Upon the Desired Line of Travel.
15 and 16. Rudder Yokes.

Is the Electric Airplane Possible?

What An Eminent Airplane Engineer Says

HENRY WOODHOUSE, the well-known aviation expert, recently gave out a report that there had been plans disclosed in Chicago for a radically new type of flying craft, to be propelled by electricity entirely, and therefore to be of such great power and efficiency as to be able to make flight around the world.

This wonderful new flying machine, he said, was designed for propulsion thru the air by electric motors driving the propeller blades, with a total horsepower of 6,000. The airplane is also credited with being capable of carrying from 75 to 100 passengers, and the wings are to have a spread of 240 feet, while the airship itself is 180 feet in length. The appearance of this new flying craft is shown in the accompanying illustration.

WHAT DR. WILLIAM WHITNEY CHRISTMAS THINKS OF THE ELECTRIC AIRPLANE.

Before going further, it would be well to listen to what a leading aviation expert, Dr. William Whitney Christmas of New York, has to say with respect to electrically-driven airplanes. Dr. Christmas is the inventor of the famous "Christmas Bullet," whose cantilever supporting wings are flexible like a bird's, but not to the same extent. The "Christmas Bullet" is the fastest plane in the world and has made 200 miles an hour on official test, when fitted with a liberty motor. Recent unofficial reports from France, mention a new record for an airplane flight of 226 miles per hour. Dr. Christmas has been connected with aviation matters from the days of Professor Langley, and his views upon the subject of airplanes are therefore of interest to us.

Dr. Christmas said: "In suggesting that airplanes be driven by electricity, I realize that I am making myself open to severe condemnation by many well informed gentlemen who say that it cannot be done. Nevertheless, I am of the opinion that the ultimate craft of the air will be electrically driven.

"It is not my part to say how this is going to be accomplished, but to argue from the present failings of the aviation gas engine to the conveniences of electric motors.

"As is well known, an airplane depends upon its motor to stay in the air and the very delicate adjustments required on common aviation motors make them not entirely reliable. There are so many parts that can wear out or get out of adjustment, that it is a wonder they show up as well as they do.

"I do not mean that they are altogether unsatisfactory, but I do say that they can be improved upon by substituting a common electric motor.

"The electric motor is compact. While the present day motors are heavier and bulkier per horsepower than most aviation engines, this is because aviation engines have been refined for the particular service on airplanes and electric motors have not. Now if our electrical geniuses put their heads down to the job of developing a fine aviation motor, they will doubtless come within the same limits that the gas engine men have attained.

"The problem of supplying the electric energy to the motor on electrically-driven airplanes is, as we might surmise, some problem! However, it is not insolvable, and there are three obvious ways to be suggested. One—to carry storage batteries; two—to transfer electrical energy by *wire* or *wireless*, i.e., as by means of a depending trolley cable between the airplane and a contact or third rail, over the contact rails of which would run a contact shoe at the lower end of the cable; and the wireless transmission of energy, referring to the ideas of Dr. Nikola Tesla, of course not developed yet to the stage of practicability; and third—a gasoline-electric airplane in which great constancy of power and beautiful control of driving screws are obtainable. In this scheme the gasoline engines drive dynamos which generate electric current, and this current is then controlled as desired by the pilot, and fed to one or more electrically-driven motors to which the screws or propellers are attached."

THE GASOLINE-ELECTRIC AIRPLANE TO THE FORE.

As the accompanying illustration shows, the layout and arrangement of the electric propelling mechanism on the newly proposed airplane described by Mr. Woodhouse, is along well-known and thoroly tried engineering lines and corresponds to the electric drive on our newest battleships.

There is not a very great loss in converting the mechanical energy developed in the gasoline engines (of which there are two in this case) into electrical energy as developed by the dynamos; and these losses are more than compensated for in applying the electrical drive to the airship, by virtue of the much smoother operating control and driving qualities. One thing is certain—that with this arrangement of gasoline-electric propulsion we know it will work!—providing we build our electric machinery sufficiently light, as Dr. Christmas has pointed out, so as not to over-burden the flying craft with useless dead-weight.

The *power-plant* here shown, comprises 6,000 horsepower of electric motors driving the four screws, or each motor produces 1,500 horsepower. The motors may be operated in pairs in case one generating set should fail, and therefore the two inside or else the two outside screws can be used.

The two dynamos develop 3,000 H.P. each and are driven by two 3,200 H.P. gasoline engines. The pilot in his cabin, atop the main body of the aircraft, has full control of the speed of the propelling screws at all times. Where the propellers can be so accurately and easily controlled, as in the case with the electric drive, the ease of handling of the airship is greatly enhanced, as for instance by speeding up the screws on one side, and reducing their speed on the other side, etc., especially in bad weather. With electrified airships there comes many other niceties for long distance journeys, such as electric cooking, electric heating, electricity for operating a powerful radio set, electric lights, and an electrical gyroscopic compass.

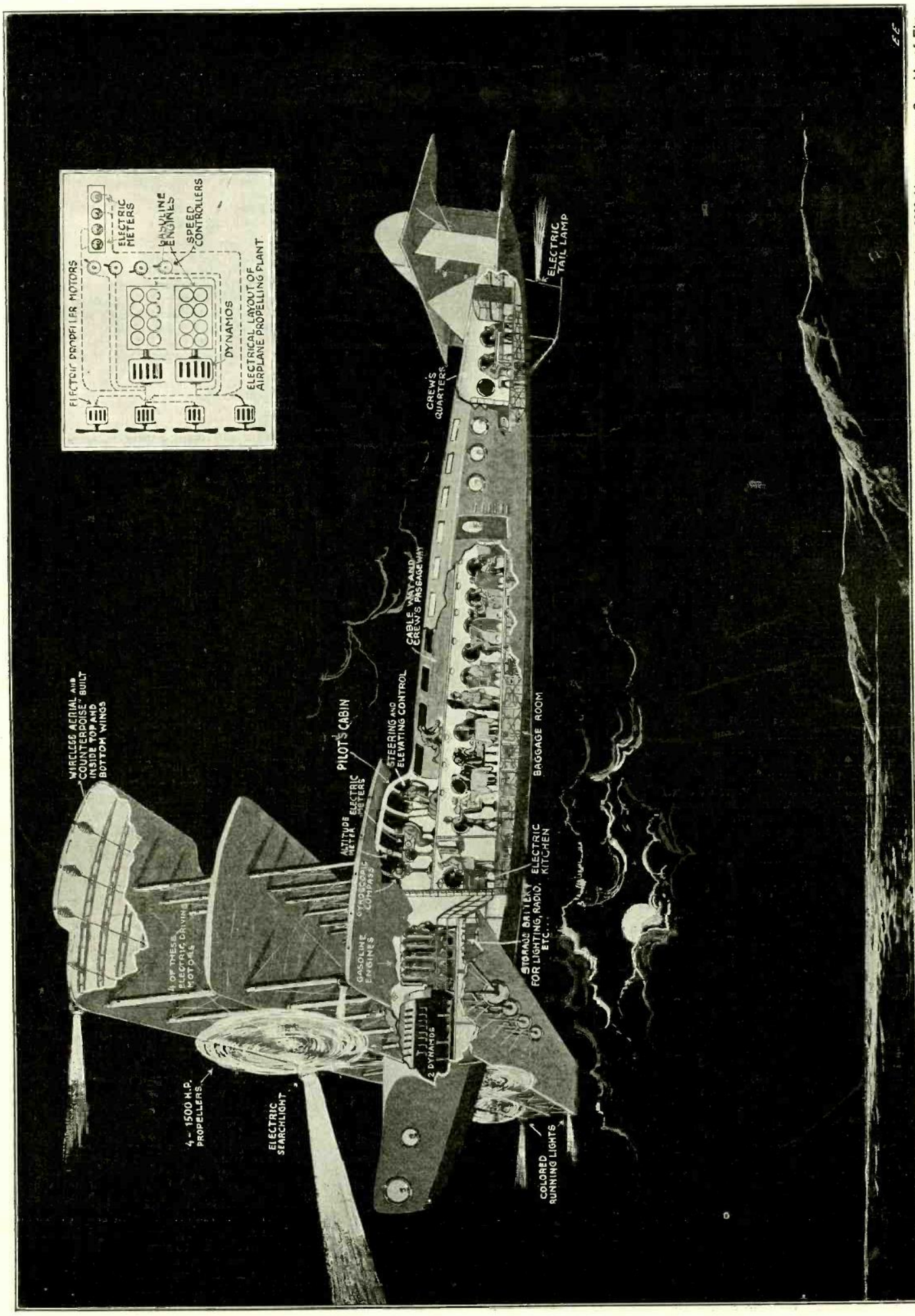
As will be noted from the illustration, the radio antenna in this machine follows the latest departure in this direction, and the wires constituting the antenna are placed inside the wings.

Objection might be raised on this point that there is considerable danger of fires owing to electric discharges from the antenna wires, but it might be said that the latest idea in building such machines is to cover the wings with sheet aluminum or aluminum alloy sheeting, in the same manner as some of the German and other foreign planes have been successfully built.

As will be seen, there is room for a limited amount of baggage on such an airplane, and for night trips, sleeping quarters may be provided on the order of the well-known Pullman car accommodations—that is, by converting the seats into berths. Powerful electric searchlights are available for flying at night, and especially for landing purposes, while port and starboard lights or *markers* are fitted on all such planes at the present time.

Heard German Conversation One Mile Away

It is a common knowledge, especially among men of the U. S. Signal Corps who served with the A. E. F., that by means of the wonderful 6, 8 and 10 stage audion amplifiers, available in the present war, and by placing a parallel loop of wire over a few hundred feet near the front lines, that enemy conversations could be easily and accurately intercepted and amplified. As we have just said, this phenomena is more or less well known, but it is not generally known, we believe, that, as recently pointed out by a U. S. radio expert who invented the amplifying radio buzzer system used in trench and field warfare carried on by the Allied troops, it was possible by the use of the high power ten-step amplifiers, both French and American type, to overhear telephone conversation and also telegraphic signals whenever the Germans happened to communicate over wires, at a distance of one mile behind the front line trenches. Interrogated at this point, the expert explained that not such a long wire loop was necessary as might be supposed, but that a wire about 250 feet long, placed parallel to the German trenches, was all that was necessary, and just to show that the "Yanks" had the "Boche" on the run long before he entered his trenches, underground dugouts and wine cellars, it is a matter of record that the Allied troops, in many instances. and particularly toward the close of the war, found whole sections of German telephone instruments over a considerable area near the front lines entirely sealed with red labels marked "Verboten," and, furthermore, some of the captives stated that their troops had been ordered not to use the telephone at all under any consideration, even where the wires were laid in iron pipes. Many other valuable uses were made of these eight and ten-step vacuum amplifiers, some of which will be described in future articles.



Electric Drive for Battleships Has Proven Eminently Satisfactory; Why Not Try It for Aircraft? Here We Have a Newly Proposed Electric Drive Airplane Rated at 6000 Horsepower, Capable of Flying Across the Continent with a Load of 100 Passengers and Baggage. Inset Cut Shows Electric Control Features.

ELECTRICAL EXPERIMENTER

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The Airship Of Tomorrow

By GEORGE WALL

WE are gradually becoming accustomed to the sight of rapidly increasing sizes of aircraft, especially those of the lighter than air or Zeppelin type, and those who had the good fortune to see the R-34, the gigantic "gas bag" which successfully flew across the Atlantic Ocean from England to America and back, will perhaps expect most anything in the airship of tomorrow. However, there are many developments in a number of these huge aircraft now proposed and being built in various countries that will prove a distinct surprise to those who have not been following the progress of aviation in the past few months.

Already in England and France they have developed and built beautiful airplanes which have a capacity of from thirty to fifty passengers, that almost outrival our finest railroad train appointments in their luxurious furnishings, parlor-car chairs and even to a wash room such as one finds on the giant *Caudron* passenger-carrying plane, recently exhibited at the great aviation salon in Paris. Here we find carpet on the floor and curtains at the windows, with panelled ceilings and electric lights.

The accompanying illustration shows what engineering refinement has done in the perfecting of living conditions for passengers on the latest dirigible or Zeppelin type of aircraft. These gigantic "gas bags" are far larger than one would first imagine, as the picture clearly shows, their height easily accommodating nine stories, equivalent to a nine-story hotel, and they propose to fit the one or more passenger com-

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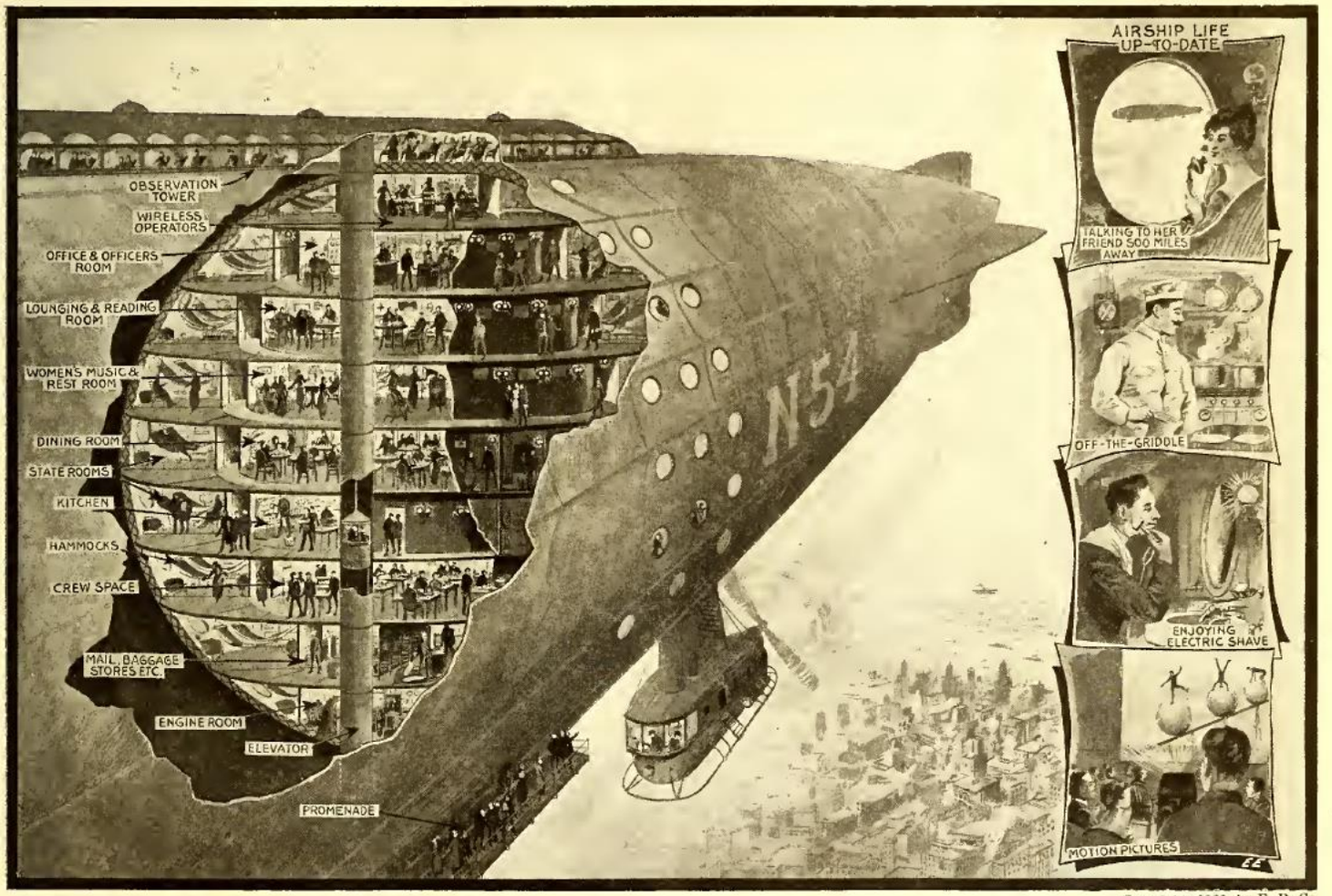

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All the Pleasures of City Life Are to Be Found in the Latest Giant Dirigible Aircraft—Even to an Electric Elevator. The Staterooms Are Arranged in Circular Fashion, Which Has Many Commendable Features.

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Power From the Wind

By H. GERNSBACK

FEW people realize the enormous amount of energy locked up in the earth's atmosphere. The amount of latent horse-power available thru the moving air currents in our atmosphere amounts to billions of horse-power annually, and constitutes one of the greatest, if not the greatest, source of energy of unharnest power available to man.

We may say that we have reached the point today where the exploitation of coal is no longer very economic. The reasons for this are manifold.

What we are doing now is to mine the coal at enormous expense, tying up an enormous amount of man power to bring the coal to the surface of the earth. Then we load this coal into trains at great expense, move the trains to far-away points—the average distance being over 1,000 miles for every car of coal. In this we not only consume *more* coal for moving the coal itself, but we block railway traffic with our long coal trains and prevent other more profitable business from taking its due course.

Of course we *have* to do it now, coal being a necessity, and we are willing to pay the price because we must have power—and must heat our houses as well. Nevertheless, the cost incurred in shipping coal from the mine to the great centers is criminal, if we stop to figure out that at the end only *one or two per cent of the energy contained in the original coal is converted either into power or into heat*, the other 98 or 99 per cent having been wasted. As man power gets scarcer and scarcer and costs rise, there will finally come a time when we must turn to other sources for our power.

The writer has in past articles mentioned many other methods upon which man will ultimately fall in his battle against Nature, but in this article we are concerned only in the exploitation of wind power.

This is not a mere dream or a visionary scheme, but there is sound engineering behind it. Wind power has been used for centuries, and the old Egyptians had their crude windmills and propelled their ships by means of wind. In this country air motors or air turbines have reached a high perfection, but they are small affairs, and are only used for local purposes, such as supplying power for private houses, farms, etc.

It is quite practical today from an engineering standpoint to build huge windmills or air turbines which in size would rank with the Woolworth building or the Eiffel tower. Such 1,000-foot monsters, while they may appear somewhat fantastic, are quite within the bounds of reality and it is calculated that they can easily furnish 25,000 horse-power for each individual windmill.

It can readily be imagined what a battery of such monsters would accomplish. Even large cities would only need a few of these giants to keep the entire city supplied with heat, light and power, and the advantage is that it makes no difference geographically where the city is located. Right here the writer wishes to propose a somewhat novel idea which does away with the greatest objection heretofore considered in such "windmill power plants."

In some localities if the energy was to be derived solely from the wind power, of course no power would be had when there was no wind. Take for instance cities located in Arizona, New Mexico, etc., or in other localities where there is no wind for days at a time. Here such a plant, on the face of it, would appear ridiculous for the simple reason that the inhabitants of a city employing such a plant would never know from day to day whether they would have power or not.

Air Turbines Converted Into Hydro-Electric Plants

Of course in most localities this would not hold, but speaking generally, there is a time period in almost any locality during the year when there would be not enough wind to supply the power to the respective cities.

Of course, the idea comes to mind immediately that a solution would be found in the use of storage batteries whereby the electrical power could be stored for emergency purposes. As a matter of fact, most large power houses in the country work on precisely this principle, but if it became a matter of storing enough power in storage batteries to keep a large city going for days at a time, the cost of such a storage battery plant would run up into many millions of dollars. Hence such a scheme at once becomes impractical. Not only this, but the up-keep of such a large storage battery coupled with the great expense of renewing the plates every few years would make the project absolutely prohibitive.

How then are we to overcome this difficulty?

The writer proposes a novel plan to use the windmills or air turbines, not to furnish electrical power direct, but *indirect*, and the underlying idea is as follows:

We will build each air turbine or windmill so large that they will deliver approximately 20% *more power than we require.* Instead of driving our electrical dynamos or generators *direct*, the windmills are not at all employed in this way. *They are used to pump water* from a lower level to a higher one, and for no other purpose. In other words, we first raise the water from a lake, river or other source of water supply, then impound this water into a reservoir. *This then constitutes our supply of power.* From the reservoir large pipes lead to each hydro-electric power station as shown in our illustration herewith, and this water drives the generators of the power stations and from it we take our power.

Now it will become apparent why we have made the wind turbines larger than actually needed. The reason is that we wish to pump up more than enough water and keep a sufficient supply on hand that, even if there should not be any wind for days at a time, we still would have enough water impounded to assure us of a continuous supply of power even tho not one windmill or air turbine was moving.

By making the air turbines larger than necessary (or by using more of them), we accomplish the purpose of impounding an immense reserve of water upon which we do not draw except in an emergency. It is the old story of the honey-bee laying in honey during the summer, which is used during the winter. In other words, while our windmills and air turbines work overtime when there is plenty of wind, we will still have enough water in our reservoir to draw upon when there is no wind.

Basically this scheme is sound from an engineering standpoint. It is simply an engineering proposition, and there is only the first cost of the moderately expensive machinery and apparatus to be considered.

Such a plant should particularly recommend itself to localities far removed from natural water power, also cities along the coast where no water power exists and where the power that *could* be derived from tidal waves is not available as yet.

It is calculated that any company who would make it a business to furnish power from such a windmill hydraulic plant could easily compete with coal even if the latter were selling at a considerably lower figure than it is today.

In our illustration we have shown two types of machines that would lend themselves for the purpose of deriving power from the atmosphere, viz.:

Huge air turbines of from 200 to 400 feet high, each of which can readily furnish 25,000 horse-power while running in a medium wind. The large windmills shown in the insert are not quite as efficient as the turbines, but are much less costly and perhaps easier in maintaining.

We are certain that once such a windmill or wind turbine is built and one locality begins using these huge air machines, the whole country would no doubt follow suit very promptly when the economy of these machines has demonstrated itself. Remember—you get the energy for nothing!

For "April"

Weighing the Earth—Written especially for the ELECTRICAL EXPERIMENTER *by the man who did it—Prof. Louis Derr, Department of Physics, Massachusetts Institute of Technology.*

Physiological Music—How the deaf may "feel" music, by H. Gernsback.

Radium—The Mother of Ionization, by Harold F. Richards, M.A.—a clever and very clearly written as well as illustrated article.

Detecting the Human Body at 600 Feet—How the military engineers developed an instrument which measured the heat radiated by the human body and spotted enemy raiding parties in the dark.

X-Rays of Unprecedented Hardness—A substitute for radium in Therapeutics, by Dr. Alfred Gradenwitz.

Talking Over a Sunbeam—By Prof. A. O. Rankine—the Bell Photophone brought up to date. Specially written for the ELECTRICAL EXPERIMENTER.

The Secret of the Magnet Poles—By Walter E. Keever.

Floating Safe for Ship Mail.

Storage Battery Repairing—By Henry Klaus.

How New York Gets Ozonized Drinking Water.

Electrifying Canal Boats and Barges—By Robert G. Skerrett.

Watching Plants Grow with Scientific Instruments—As Well as Measuring and Indicating the Effects of Electric Shocks and Chemicals Applied to Plants. The remarkable work of Sir Jagadis Bose.

Electro-Medical Frauds—By Joseph H. Kraus.

The Dark Searchlight—By Louis Yeager.

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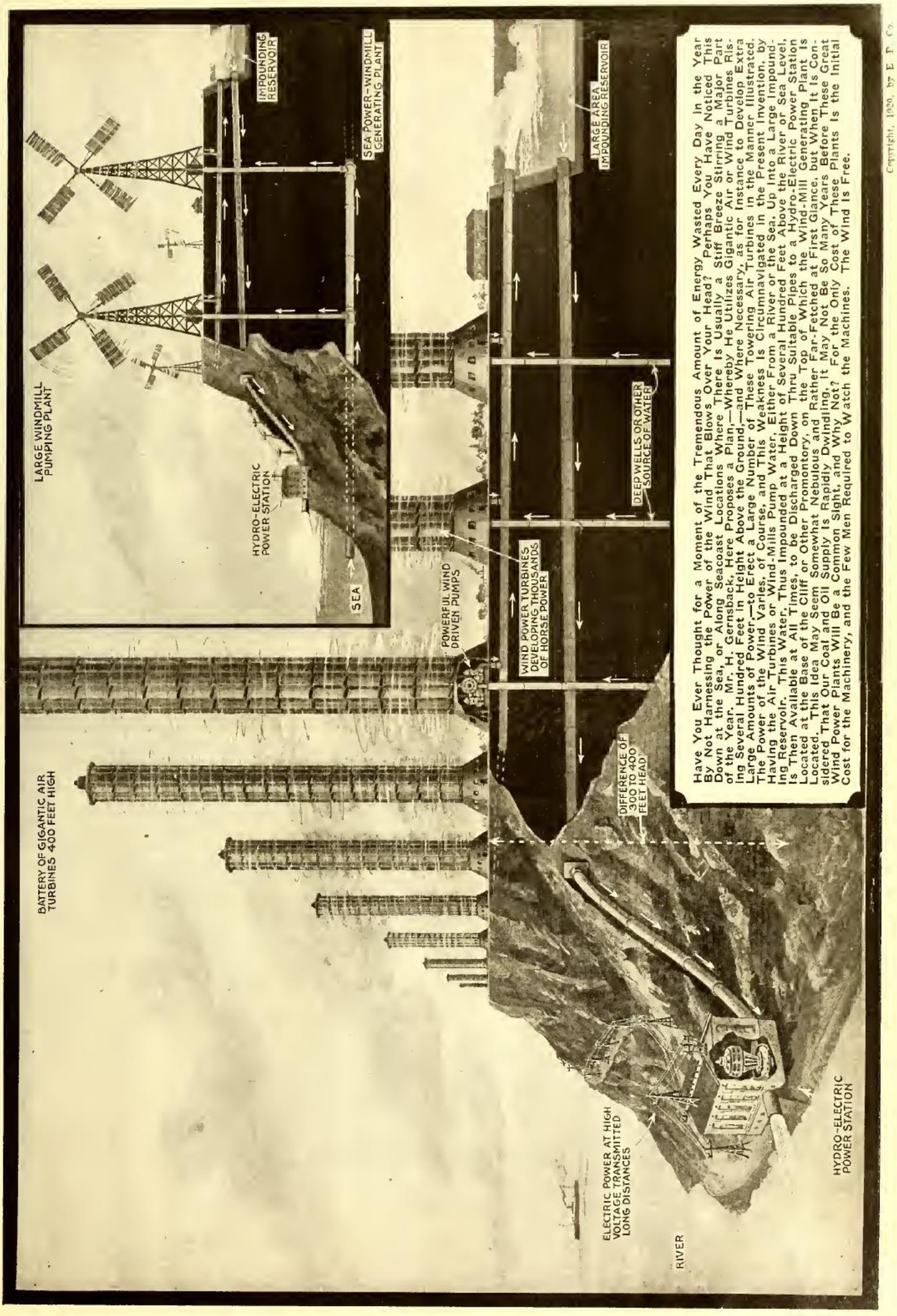
NEW HYDRO-ELECTRIC WIND-POWER PLANT



Have You Ever Thought for a Moment of the Tremendous Amount of Energy Wasted Every Day In the Year By Not Harnessing the Power of the Wind That Blows Over Your Head? Perhaps You Have Noticed This Down at the Sea, or Along Seacoast Locations Where There Is Usually a Stiff Breeze Stirring a Major Part of the Year. Mr. H. Gernsback, Here Proposes a Plan,—Whereby He Utilizes Gigantic Air or Wind Turbines Rising Several Hundred Feet in Height Above the Ground,—and Where Necessary, as for Instance to Develop Extra Large Amounts of Power,—to Erect a Large Number of These Towering Air Turbines in the Manner Illustrated. The Power of the Wind Varies, of Course, and This Weakness Is Circumnavigated in the Present Invention, by Having the Air Turbines or Wind-Mills Pump Water, Either From a River or the Sea, Up Into a Large Impounding Reservoir. This Water, Thus Impounded at a Height of Several Hundred Feet Above the River or Sea Level, Is Then Available at All Times, to be Discharged Down Thru Suitable Pipes to a Hydro-Electric Power Station Located at the Base of the Cliff or Other Promontory, on the Top of Which the Wind-Mill Generating Plant Is Located. This Idea May Seem Somewhat Nebulous and Rather Far-Fetched at First Glance, but When It Is Considered That Our Coal and Oil Supply Is Rapidly Dwindling, It May Not Be So Many Years Before These Great Wind Power Plants Will Be a Common Sight, and Why Not? For the Only Cost of These Plants Is the Initial Cost for the Machinery, and the Few Men Required to Watch the Machines. The Wind Is Free.

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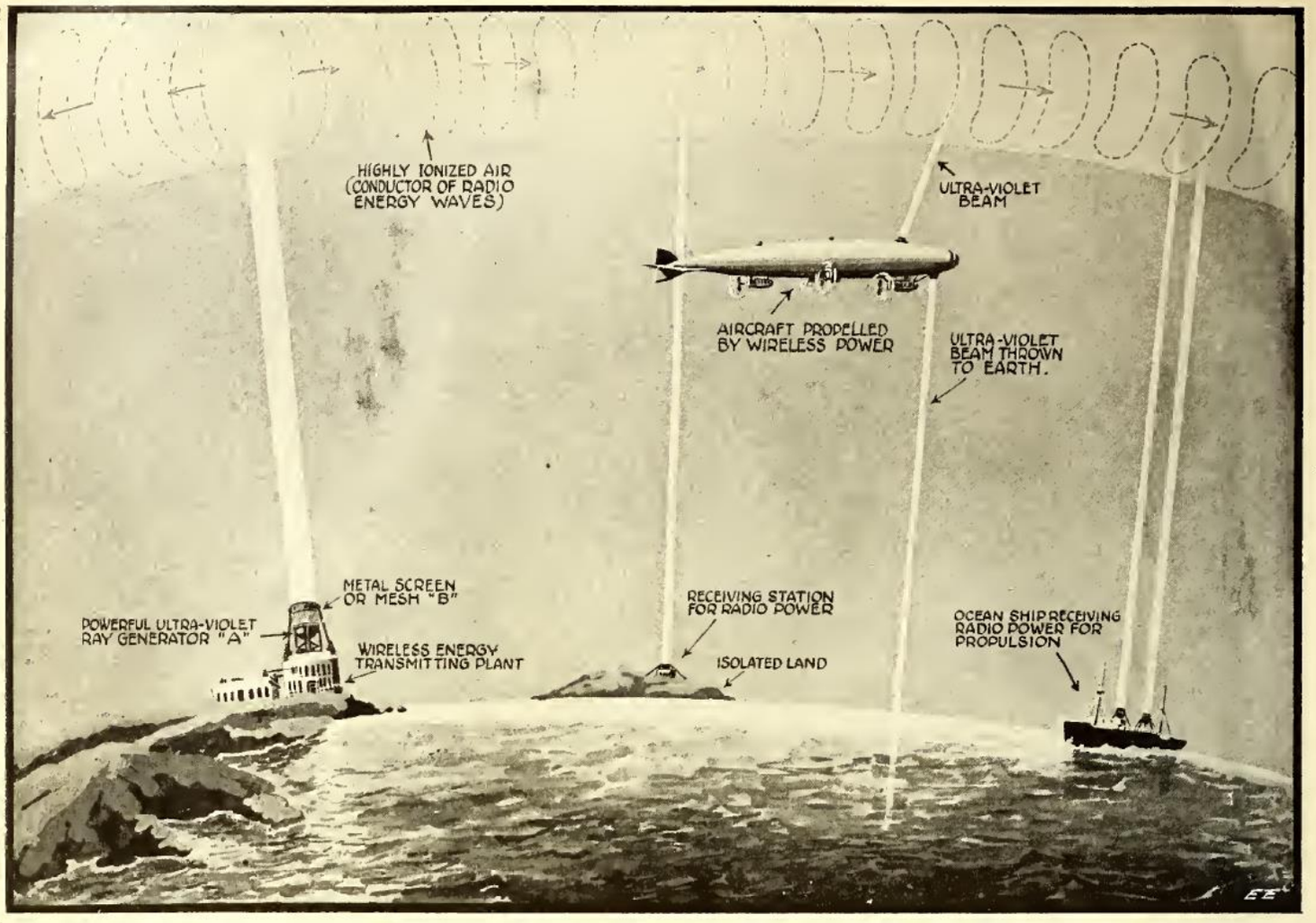

Showing the Wireless Transmission of Power by Means of Ionized Searchlight Beams. Powerful Tesla Currents of High Potential and Frequency Are Imprest on the Ionized Beams and Received from Similar Beams as Shown.

Wireless Transmission of Power Now Possible

By THOMAS W. BENSON

RECENT developments tend to fulfill the old, old dream of power transmission without wires. For years men have labored in vain to transmit power without wires and thus solve a myriad of transportation problems, such as propelling vehicles, ships, trains, aircraft, etc., without having to include a source of power in their construction. It makes one's head almost reel to think of the possibilities in such an achievement and now the dream promises to come true.

By one bold stroke an English genius, Mr. John Hettinger, has unthinkingly opened up the way for its realization. Like numerous other inventions, the way lay before our very eyes, but we were all too blind to see it.

While working on a means for transmitting radio waves without material aerials, Mr. Hettinger hit upon the idea of using ionized light beams as elevated conductors. Obviously simple when one thinks of it.

It is a well-known fact that an ionized gas is a conductor; in fact, the conductivity of a gas is a measure of its ionization. Furthermore, it is possible to ionize a gas by means of a stream of ultra violet rays. Working with these facts, Mr. Hettinger devised means to utilize them for radio transmission in the following manner.

As shown in Fig. 1, a source of ultra violet rays, an arc or mercury vapor lamp, A, is arranged to throw a beam of ionizing rays vertically.

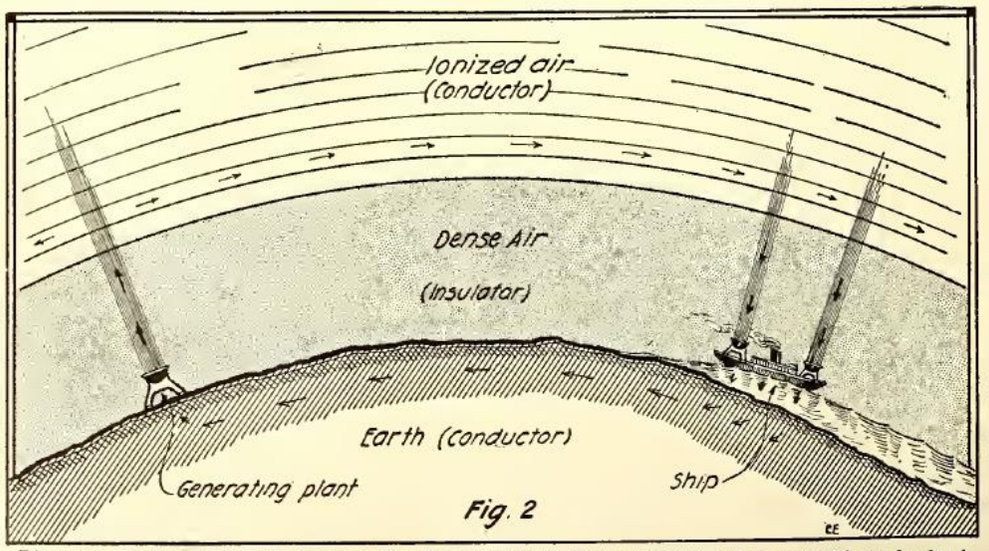

Diagram of the Author's Scheme for the Wireless Transmission of Power Thru Ionized Light Beams and the Upper Ionized Strata of the Atmosphere.

These rays result in an ionized stream of air that acts as a conductor, the surrounding un-ionized air being practically a perfect insulator. By making connection to this conducting beam with a metallic screen or mesh at B, it can be utilized as an aerial for radio communication.

We are perfectly aware that this ionized beam rapidly loses its conducting power

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as the distance from the source increases, therefore the effective height of such an arrangement is determined by the intensity of the ray generator. So much for the idea as applied to radio communication.

But let us consider further. In studying the spectrum we find that the sunlight on reaching the earth contains few ultra violet rays of shorter wavelengths than 3,000 Angstrom units, yet we are able to generate much shorter rays with an arc light. It is unreasonable to assume that shorter waves do not leave the sun, and in view of the fact that it has been determined that the upper stratum of our atmosphere is ionized, it is accepted that the shorter rays are absorbed to cause this ionization.

It will now be apparent that a very good condition exists for the transmission of energy without wires. As shown in Fig. 2, we have the earth, a good conductor, surrounded with a blanket of insulating air about ten miles thick, beyond which, up to about a hundred miles, the air is highly rarefied and kept in a state of ionization by light from the sun and stars.

Hence, we have two good conductors separated by several miles of atmosphere, practically a perfect insulator, an ideal arrangement for our purposes. We have but to connect a source of current to the earth and to the ionized strata of air and energy can be transmitted entirely around the earth without wires. The energy could be utilized in any part of the earth by merely connecting to the pair of conductors.

This condition has been recognized for some time, but the difficulty lies in making connections to the upper layer of conducting atmosphere. It is hardly practical to construct towers six or seven miles high for the purpose, then again the energy could not be utilized without using a similar structure at the point of reception, which makes this scheme hardly feasible for aircraft or moving vehicles.

Return then to the ionized stream for radio aerials. We can easily construct arcs that will throw a beam ten or twenty miles. Then why not make connection to that upper stratum with an ionized stream of air? Wonderful in its simplicity.

In Fig. 2 the writer attempts to portray a generating station embodying these principles. In the main building will be housed the generating units for supplying the current to the arc and the primary of the high voltage apparatus for transmission of energy. Supported on the roof of this structure will be a monstrous arc lamp capable of throwing a stream of ultra violet rays for at least ten miles. In this beam is supported a conducting screen to make connection to the conducting stream of ionized air. The insulation of these parts present no great difficulties to modern engineering.

The building will also house a huge step-up transformer, a set of high voltage condensers, a spark gap either of the rotary or quenched type and a huge oscillation transformer or Tesla coil. These instruments are connected in the usual manner and tuned so that the inductance in the circuit and the capacity formed by the earth and ionized upper strata will have a well defined oscillation period.

By these means the whole earth will become an electrified body, energy to be drawn at any point by simply making metallic connection to the earth and pointing a beam of light vertically, a screen being used to take the energy that will flow down the beam. An inductance coil being necessary in the circuit to insure resonance with the transmitter at the receiving set. After once started, the receiving energy can be used to keep the arc going.

Ships will have an arc and reflector mounted on the masts, aeroplanes have two arcs, one on top, the other below, and so on.

This scheme will not interfere with present short range transmission, it being hardly practical for each home to have an arc on the roof when one arc would serve for a town and several for a large city.

Rather its benefit will lie in the utilization of water falls far from civilization, now unused on account of difficulties in transmitting the power hundreds or thousands of miles.

Aside from the transmission of power other advantages may accrue. Will such a stress between the earth and upper air strata reduce the presence of dust particles in the atmosphere? Or, again, cause the immediate condensation of fogs and moisture in the air to give us perfectly cloudless days? Perhaps it will become simply a matter of changing the frequency or voltage of the current to cause rain or to prevent it.

Then the question of effect on radio communication: will it make our present sets obsolete, a transmitter of the future being connected directly to the power set and acting by superimposing different frequencies on the power frequency? Or will radio-telephony work hand in hand with the power system, the voice currents being imprest on the power circuit and filtered out at the receiver?

There are a thousand and one things such an arrangement might effect. Will trees and vegetation increase in growth as experiments in electrical culture would indicate? What effect would such stresses have on germs and bacilli? Their numbers will be decreased by the destructive effects of the ultra-violet light. Will man grow to an unsuspected height and become uniformly healthier due to the electrical treatment he would be constantly undergoing?

And so on—conjecture is without bound, but the scheme is practical to all appearances; it requires but some financial genius to give it a trial.

And to think it all was within reach such a short time ago! Had Tesla but put a gigantic arc on top of the tower of his experimental station in Long Island accurate data would be at hand now—were it but even a promise it would mean another step towards the final mastery of all matter by man.

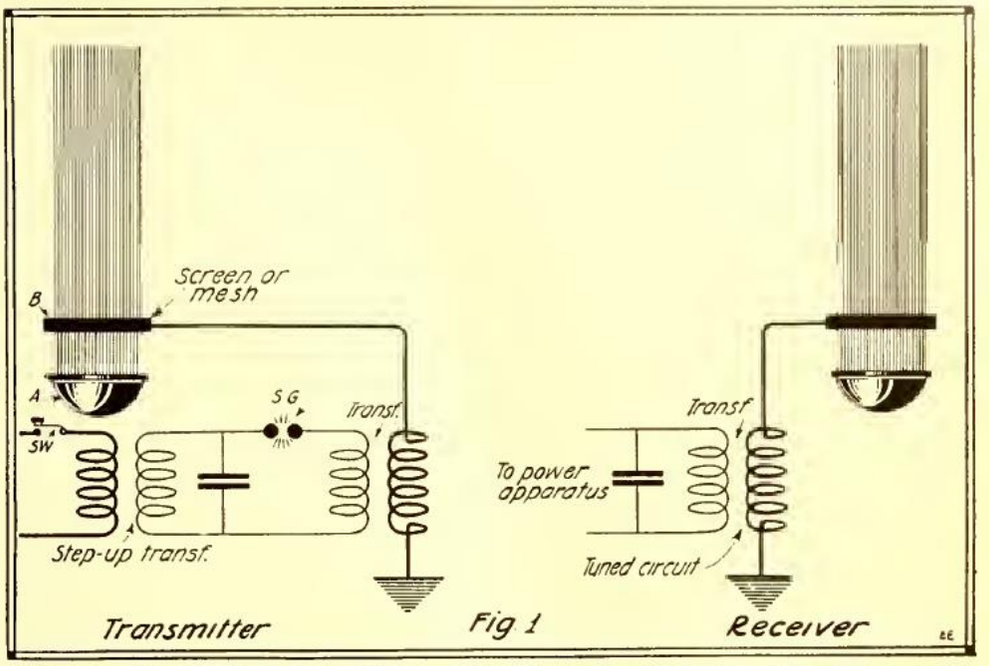
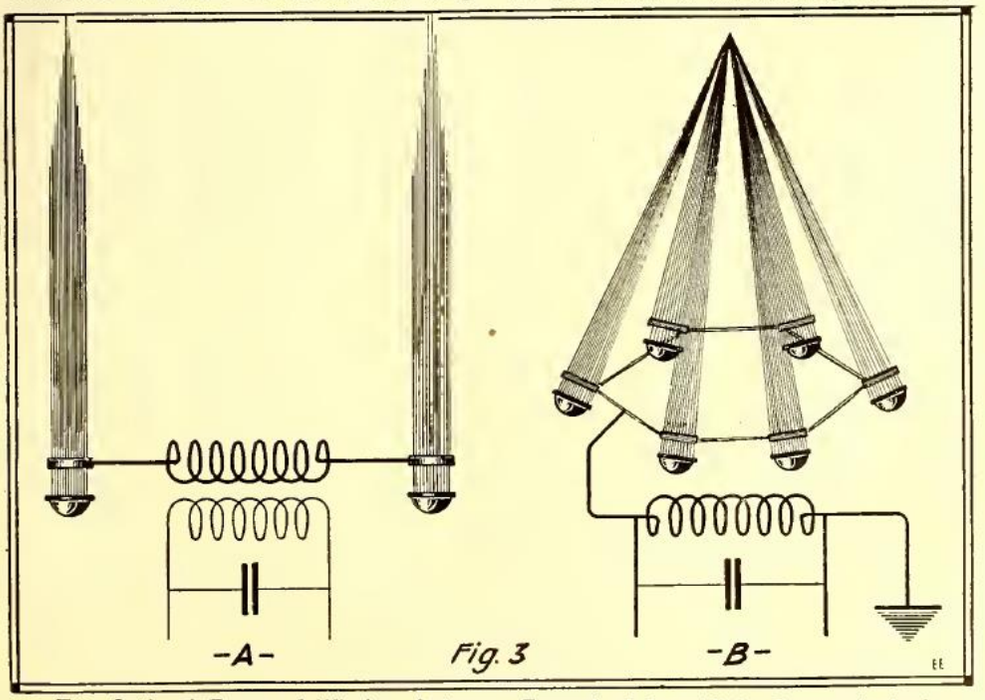


Diagram Showing the Transmitting and Receiving Circuits for the Transmission and Reception of Electric Power by Wireless.



Two Optional Forms of Wireless Antennae Formed of Searchlight Beams—Ionized Atmospheric Streams.

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Huge Siphon Tidal Power Plant

By H. WINFIELD SECOR

How Sea Water is Siphoned into and out of Reservoir, Developing Electric Power Either Way

FROM time to time, some budding genius comes out before the world with a startling invention with which he proclaims that he intends to harness the power of the ocean waves or the power of the tides, whether these be created by ocean, river or lake action, primarily. Most of these schemes die a natural death while reposing in the vaults of the U. S. Patent Office, even tho the patents may eventfully be issued on the more or less successful looking inventions.

One of the most ingenious ideas that has been proposed recently in the realm of tidal power plants is the one illustrated herewith, and which has been invented and patented by Mr. Charles Herbert Talmage of New Bedford, Mass. The inventor certainly deserves a great deal of credit for the way in which he worked out the various details of this tidal power plant and the means for applying it in practise, especially in the clever construction of the collapsible dams, which are caused to rise and fall by water pressure.

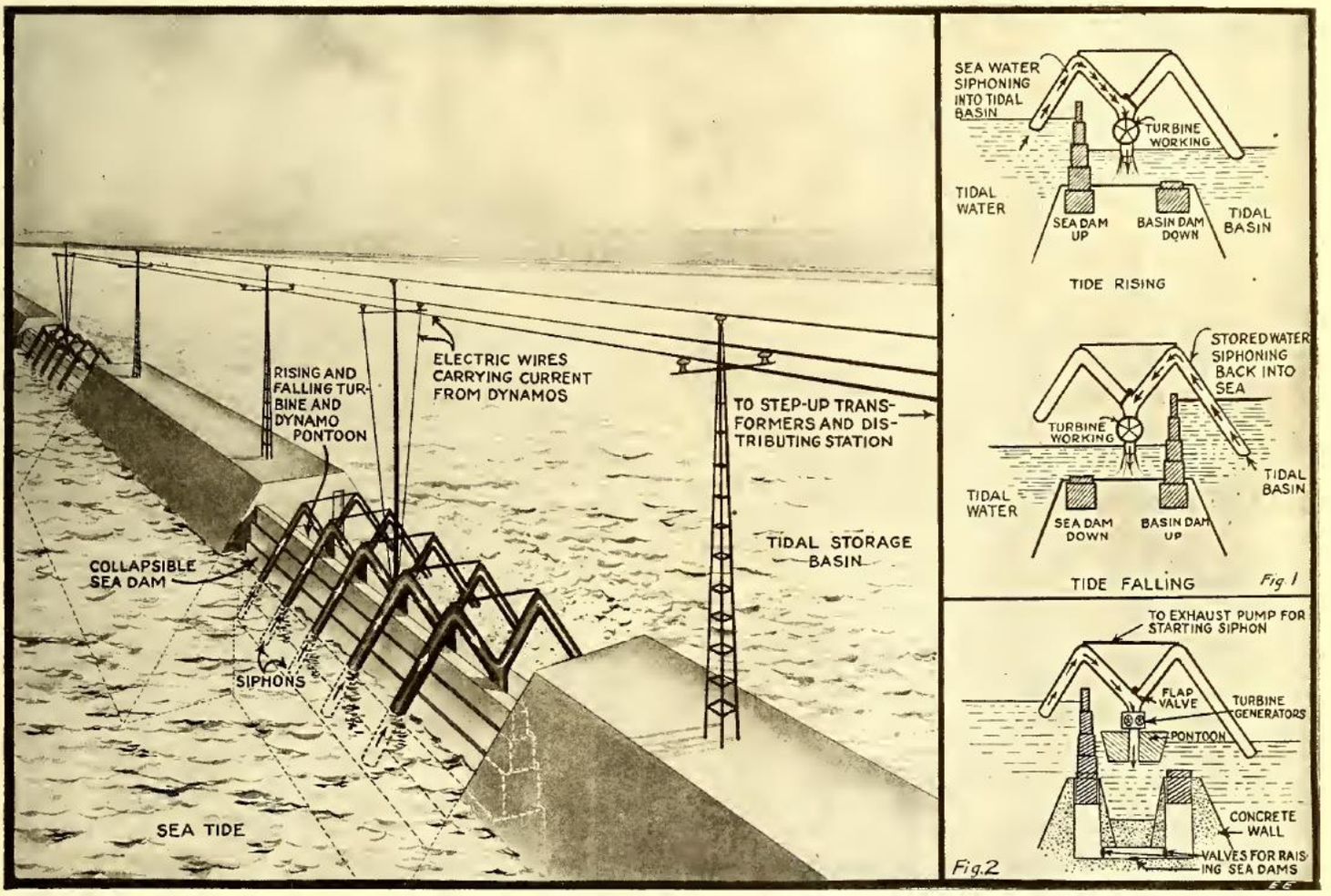
The accompanying illustration shows clearly just how Mr. Talmage proposes to reap useful power from the gigantic tidal actions occurring along our great sea coasts and other locations such as along rivers. In brief, the principle underlying the operation of this tidal power plant is as follows:

By referring to the small detail illustrations herewith, it will be seen that as the ocean tide rises, for example, that the water within the large reservoir or tidal basin will be at a lower level. As the ocean tide proceeds to slowly rise, the sea dam is raised by hydrostatic pressure or water pumped into it by suitable means, while the turbine float with its two or more attached siphoning pipes rises correspondingly. All the while water is flowing from the sea up thru the siphons and out thru the turbines into the tidal basin as shown by the arrows.

In the first place, the siphon action is created by exhausting the air from the left hand siphon, thru the small pipe connecting the tops of the two siphons, and which is joined to a suitable exhausting apparatus or machine, not shown. This action keeps up until the sea tide has risen to its highest level and shortly after which period the level of the water in the tidal basin will have risen to a similar height.

As soon as the sea tide begins to fall or ebb, then the reverse action is set up by opening the valve at the basin siphon just above the turbine, and closing off the left hand siphon, as clearly shown in the second detail illustration. A vacuum is created in this siphon by the action aforementioned, and the water is caused to flow from the tidal basin, into the right hand siphon, down thru the turbine and into the sea again.

The pontoon containing the turbines and dynamos falls with the sea tide, and the basin or right hand dam is slowly collapsed by emptying the water out of it. In this way power is developt practically all the time, while the sea tide is rising and while it is ebbing, and useful energy is thus realized from the tidal power itself, without any expenditure of money for coal or other source of energy, the only actual expense being that for the operating personnel and the initial cost of the installation of the machinery and dams.



Remarkable New Tidal Power Scheme Utilizing the "Siphon" Principle—the Water Is First Siphoned from the Sea Into the Impounding Reservoir and Afterward, on Falling Tide, Siphoned Back Into the Sea. Either Way the Turbines and Dynamos Extract Their Quota of Energy from the Flowing Water.

As the large perspective view shows, a substantial and adequately strong wall has to be erected along the sea front, to withstand the pounding of the waves and also to serve as a restraining wall for the impounding reservoir and the millions of cubic feet of water which would be siphoned into it from the sea. The inventor's designs call for siphon, turbine and generating units mounted in groups of five, which is a very good idea, and several of these units can be grouped along the sea wall in the manner illustrated.

At the present time, engineers and others are rather wont to scoff at what to them appear to be radical and impractical tidal

(*Continued on page* 1178)

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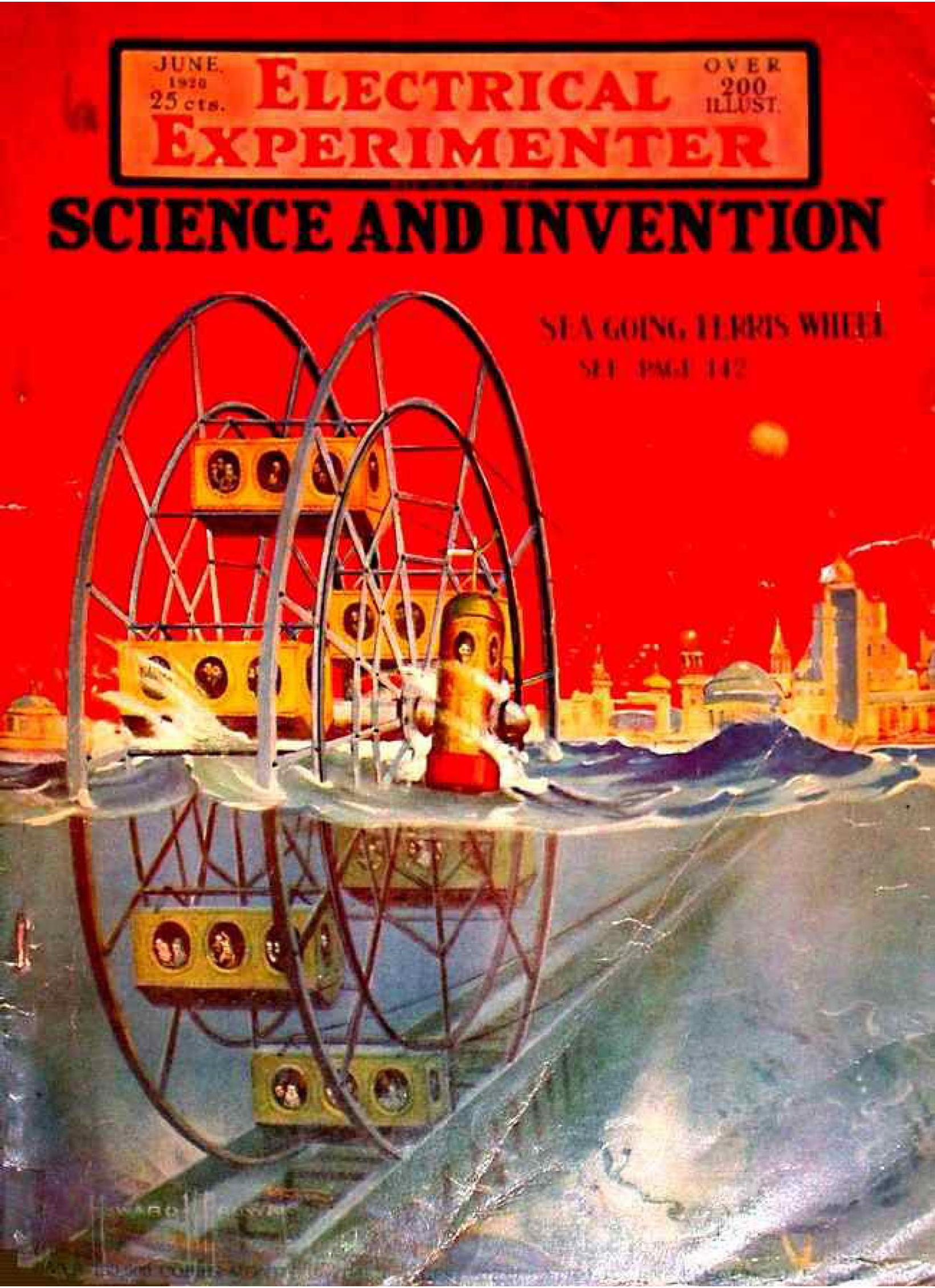
SCIENCE AND INVENTION

SEA GOING FERRIS WHEEL

SEE PAGE 112



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H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

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Signal Buoy for Ocean Ships

By EDWIN F. LINDER, M. E.

A Radio And Searchlight Buoy to be Carried By Ocean Ships

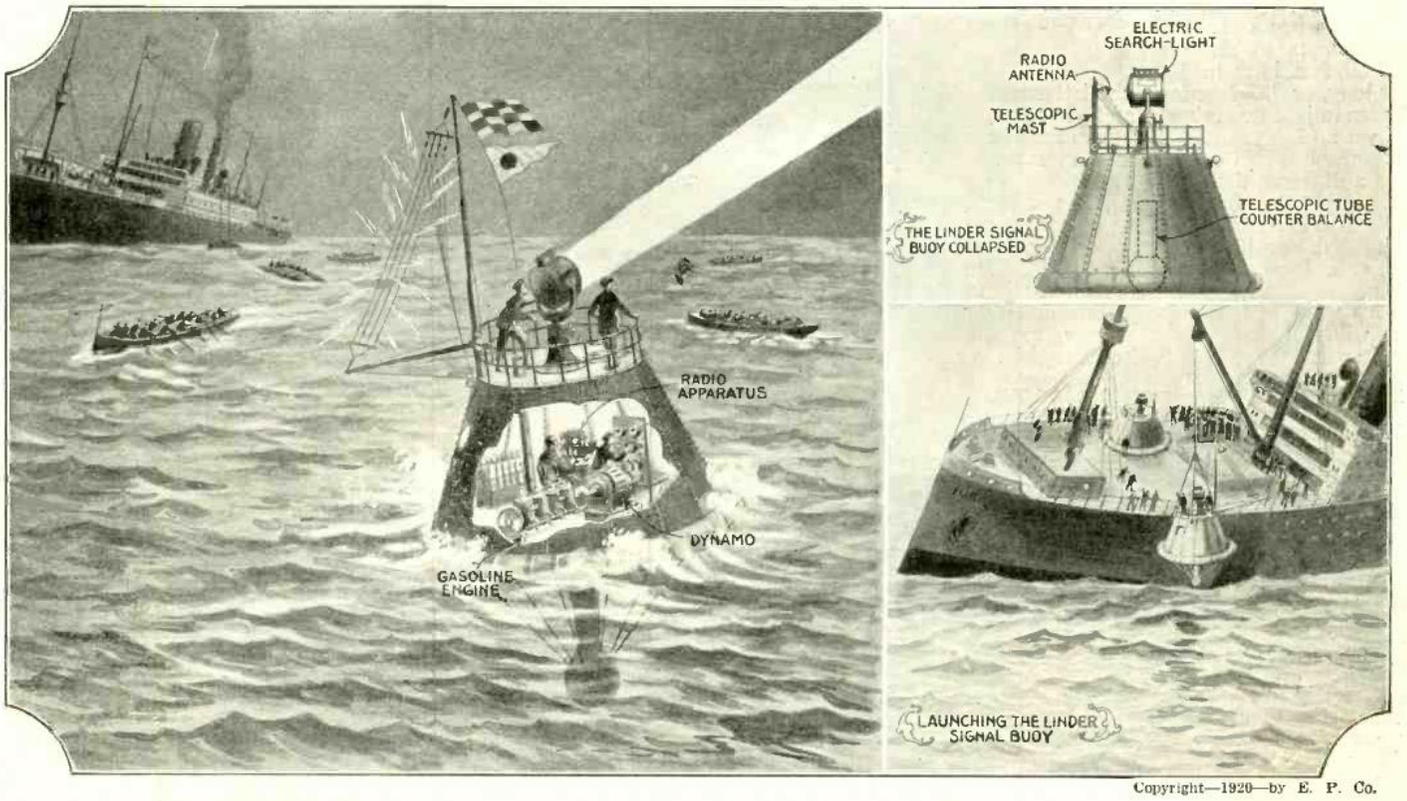
THE searchlight signal buoy is primarily a life-saving device; however, it is not designed to replace the customary lifeboats and rafts with which all modern ocean-going steamships are equipt at the present time.

A hollow double bottom ring about twenty feet in diameter serves as the float of the buoy. Upon this is constructed the housing and the bridge on which the powerful electric searchlight is mounted. The entire construction is light sheet steel reinforced with angle iron. Underneath the float on its axis is a telescopic counterbalance, so weighted that it prevents the buoy from being overturned when in a rough sea. This counter-balance is extended on lowering the buoy over the side of the vessel when it becomes necessary in the case of accident at sea, and when it has reached its full length it is locked by the operator from within. Wire rope stays, made fast to the outer surface of the float, take the tension and hold it firmly in a central position.

In the machinery compartment a gasoline engine furnishes power for the electric units necessary for the operation of the searchlight and wireless apparatus. The mast of the aerial for the latter is made up of telescopic pipes so as to be out of the way when the buoy is being lowered from the vessel's deck to the water.

When not in use the buoy (one or more) is carried on the forward deck of the steamer before the mast with wire rope slings attached to the rings fastened around the top of the sheet steel housing for that purpose. The slings come together above the searchlight and at this point are hooked into the usual boom tackle, ready to be put overboard instantly at the word of the commanding officer of the ship. While on deck the counter-balance is telescoped and is flush with the bottom of the float, making a solid flat face for the apparatus to rest on.

(*Continued on page* 225)



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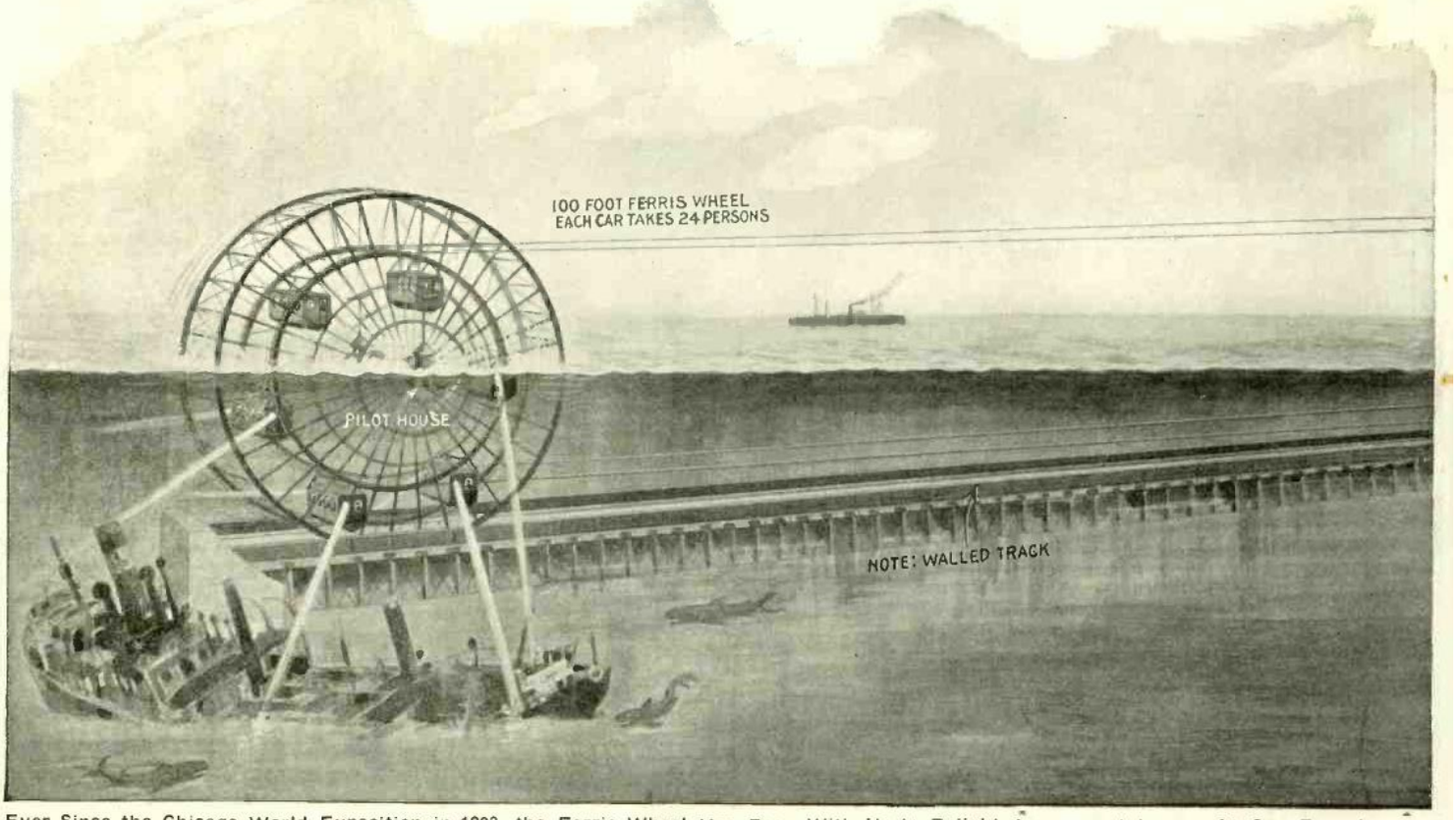
When a Ship Collision Happens at Sea, and Altho Practically Every Vessel Today Carries Wireless Signaling Apparatus, It Has Often Occurred That a Ship's "S.O.S." Calls Have Failed to Bring Assistance in Time, for the Reason That the Dynamo Room Became Flooded Almost Instantly. An American Inventor Here Proposes a Complete Radio and Searchlight Signal Buoy Which Could Be Released From the Ship Instantly, No Matter How Sudden the Ship May Sink, the Buoy Being Released by Push Button Controlled Clutches. The Searchlight, Besides Calling for Aid Over a Hundred-Mile Radius, Helps to Keep the Life Boats Together

A Sea-Going

By H. GERNSBACK



Ever Since the Chicago World Exposition in 1893, the Ferris Wheel Has Been With Us to Delight Amusement Lovers At Our Expositions and Beach Resorts. The Latest Improvement On the Stationary Ferris Wheel is Shown Above. It Consists of the Regulation Wheel, Which With Certain Additions is Made to Roll Upon a Track, Out Into the Sea, Lake, or Other Body of Water. The Track Being Inclined Into the Water, the Wheel Rolls Down By Gravity. It is Pulled Back By Means of Two Steel Traction Cables as Shown. The

THE good old Ferris wheel has been with us for many years now, and ever since it was invented by G. W. G. Ferris, who erected the first one at the World's Exposition of 1893 at Chicago it has not been much improved upon. When it first came into use at our sea-shores and amusement parks, it was considered a wonder, but during the last decades the novelty has worn off.

Last year the writer took a trip on one of these wheels and was imprest by the lack of popularity in the device. There was no great crowding, and the writer particularly remembers a remark past by a young girl who refused to take the trip, giving as her reason that "it was not exciting enough for her." This seems to put the finger right on the whole crux. It is not exciting! Hence it has fallen into disuse with the amusement-seeking, merry-making crowds.

Another thing with which the writer was imprest on his trip was the cumbersome way of loading and unloading the passengers of these Ferris wheels. Once the cars are loaded, the wheel may spin merrily, but the loading and unloading is another matter. As each car comes down, the wheel must be stopt to allow one set of passengers to get out and allow another set to get in. Consequently it will be seen that there must be as many such stops as there are cars to the wheel. Loading and unloading thus takes an average of 10 to 15 minutes, which does not improve the temper of the occupants who expect speed and excitement.

For these reasons and various other ones, the writer advances a radically new idea which is shown graphically here, and also forms the subject of our cover illustration. The writer has simply taken a Ferris wheel, and instead of revolving it on its axis, he has placed it upon a steel track and rolls it out into the water as our illustration well depicts. The object is twofold. First of all a new brand of sensation is had, so much craved for by our present amusement seekers. Secondly, the old and well establisht features of the Ferris wheel are kept and improved upon as well.

The idea which forms the subject of a patent is in brief as follows:

The Ferris wheel runs upon a special kind of track, which latter is built right into the ocean, lake or other water body, the tracks being supported by the regulation piling work, similar to that on which our ocean piers are built. The track itself, as will be noted, should be inclined; the slope being inconsiderable. Using a hundred foot Ferris wheel, the track may run out into the water a thousand feet or more, all depending upon the expense the builders wish to go to. At the end of the track there is a concrete safety pier, which stops the wheel should the supporting cables break.

The mode of propulsion is rather simple. You have no doubt seen the principle many a time, particularly before prohibition arrived. Surely you have seen how a beer keg or wine barrel was lowered by means of two ropes down the stairways into the cellar. Two ropes would be slung around the barrel, and two men would play out the ropes as the barrel descended easily and gracefully down the incline stairs and into the cellar. The same principle is made use of in the present invention. As will be seen there are two steel cables, both running parallel to each other, one side engaging a circular sheave of the wheel, while the other side connects to the power house.

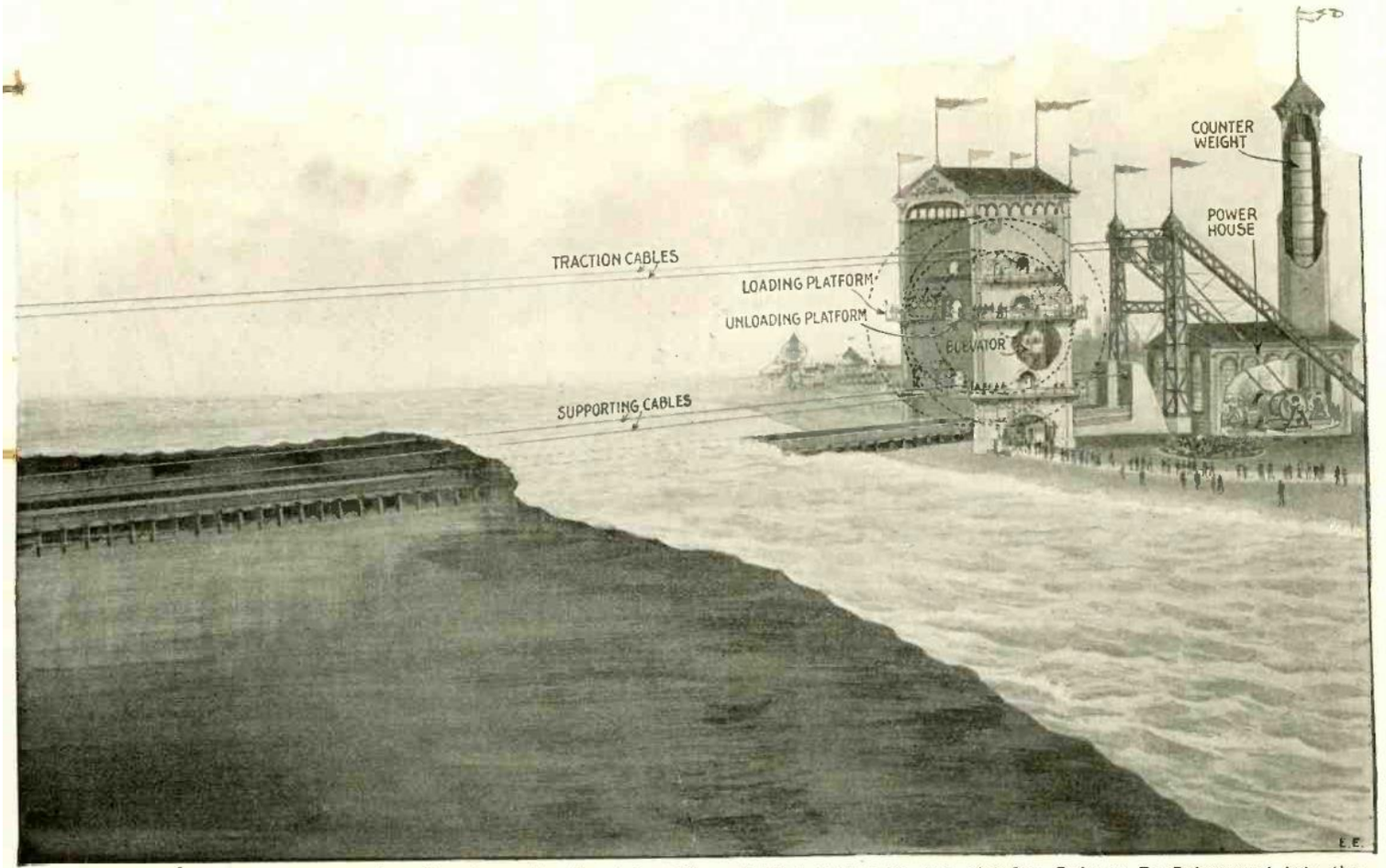
In the position shown in our illustration above, the wheel has arrived at the end of its trip and is now pulled landward again by means of the two traction cables which wind up on huge drums in the power house. Very little power is required inasmuch as big counter weights are used which practically pull in the wheel themselves. Only a small amount of power, let us say a 50 H.P. motor, is required to bring the wheel back to land. On its outward trip practically no power is required, the wheel running down the incline by gravity, the traction cable simply paying out; the action is, of course, under the control of the men at the power house, who will see to it that the wheel does not go too fast for reasons which will be apparent hereafter.

Let us now take an imaginary trip in this future sea-going Ferris wheel, and see what happens.

After paying our fare, we ascend by means of elevators on to a loading platform, and we will find that there are three such platforms. The cars of the Ferris wheel come into a resting position level with the platforms, the top platform and the bottom platform each accommodating one car, while the second and third platforms each accommodate two cars. The device is made so that, inasmuch as there are six cars and the wheel always returning in its same position, the cars will always stop at their assigned platforms and not otherwise.

We now enter one of the steel cars, each car accommodating 24 persons. There is not much room offered us, and every inch of available space has been taken advantage of, as we must not have too much buoyancy, otherwise it will take too great a weight to pull the cars down below the level of the water. For that reason the

Ferris Wheel



Passengers in the Water-tight Cars Experience the Novel Sensation of First Rising Up Into the Sky Only to Be Submerged Into the Water. The Maximum Immersion is About 50 Feet. The Experience Which is Gained in Submarine Building, Makes It Possible for Us to Make the Cars Thoroly Safe in All Respects, Without the Passengers Undergoing Any Risks Whatsoever. A Novel Means for Loading and Unloading the Cars is Shown as Well in the Present Invention, Which Does Away with the Tedious Starting and Stopping of the Old-time Ferris Wheel. The Sea-going Ferris Wheel Will Probably Be Built At Coney Island Next Season.

ceiling or roof of the car is very low.

There is just enough room in the cars to allow people to sit comfortably, and when the car is full there is not much room left.

We note that the windows are made of thick plate glass one inch thick, and that the room can be lighted by electric lamps, fed from a storage battery placed under the seats. It being a hot summer day, several small fans are kept running to circulate the air. We note the thick, massive steel walls of the car, and our particular attention is directed to the steel door which slides up and down like a window in air and water-tight brass fittings. This door is raised and lowered by means of a rack and pinion and forms an absolutely water-tight closure, which does not permit a drop of water to get by. Similar water-tight doors are used on all of our battle-ships and modern steamers, which connect the bulk heads, and which can bear enormous water pressures without allowing a drop of water to leak.

All the cars being loaded simultaneously in less than two minutes, we faintly hear a shrill whistle outside, and we are off. Slowly and majestically the big wheel begins moving, and keeps on moving at a steady gait. The sea-going Ferris Wheel is not intended as a racing device—quite the contrary, it only moves at about three or four miles per hour. Pretty soon the wheel begins to dip into the water, and as our particular car is way up in the sky, we have as yet to experience our first "dip" into the ocean. In a few seconds, we dive into the surf gracefully, and we experience the thrilling sensation of sinking into the green ocean water, while the spray of the big waves break against the thick glass windows, slightly swaying the car. Truly enough, here is sensation and excitement sufficient to please the most blasé. Down, down we go, and we note that the sunlight becomes dimmer and dimmer as we dip further into the water. This, however, only lasts for a few seconds, and suddenly we are aware that we *seem* to be moving backwards. The reason of course is that the car is now going the other way, and soon will dip out of the water entirely. In a few seconds, we are out of the water again, and are soon once more high up in the air, only to dip down still deeper into the water than the first time. As we go down for the last time, we know that we are about 50 feet below the water level, and here it is almost dark, very little sunlight coming down to this depth.

The attendant now turns on a little searchlight, and we can see small and large fish swimming about curiously. At the end of the track, we also make out the dim outline of a stranded steamer buried in the sand many years ago. It gives us a good view of what a sunken steamer looks like, and how it has disintegrated with age. As the wheel only stops for a few seconds, we have not much time to notice all the submarine wonders, for soon the wheel starts rolling back, and we dip out of the water once more.

We note that every time the car dips out of the water, an attendant turns a hand wheel, which is for the purpose of renewing the air in the car. A pipe connects somewhere with the roof of the car, and this pipe lets in fresh air every time the car rises from the water. A funnel-shaped cover prevents the water from entering the car when air is let in, while a suction fan forces fresh air into the car. This change of air is greatly welcomed because there is not too much air in the cars anyway, and while the entire trip only lasts about 20 minutes, and tho the original air would be sufficient to keep everyone comfortable during this time, it is far better that the air should be renewed, giving the passengers a chance to get a breath of clean and fresh sea air.

Soon we are back on *terra firma* once more, and arrive at our unloading platform. The door is slid open, and we emerge to make room for subsequent passengers.

So far for the whole trip. Our illustration shows the other items which the passengers do not see. For instance, there are two pilot houses attached to the hubs of the wheel. Each one of these pilot houses has a semaphore arrangement on top of its little housing, which is used by the pilot to inform the land station in case anything goes wrong, but more for the purpose to start, stop, or accelerate the speed of the wheel or for any other purpose. The passenger cars have a triangular attachment at the bottom for two reasons. If the car was entirely flat, it would have difficulty in making its dive into the water. Secondly, inasmuch as we have a large buoyant body in the form of the car itself, we must weight it down to such an extent that it will not float. If it were floating, then the car would overturn and spill the passengers inside of the car. For that reason, the triangular appendage of the car is weighted with iron to overcome the natural buoyancy of the car. A good percentage of the buoyancy of the car itself has been destroyed by the great weight of the car (built of 3/8" steel), but this is not sufficient to sink it, hence the ballast weight is needed. It is necessary also to have the car good and heavy for if

(*Continued on page* 205)

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SCIENCE & INVENTION

HICAGO'S NEW MONORAIL

SEE PAGE 262

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VIII. Whole No. 87 July, 1920 No. 3

Compressed Air for the Sick

By GEORGE WALL

THERE are many people today who believe with the Christian Scientist, that there are at least a number of better ways for treating and curing the sick for the various ailments our human flesh is heir to than by pumping into the unfortunate victim's stomach a continual string of herbs, pills and oils.

One of the very latest scientific developments of a radical nature in medical practise is the invention here shown of Dr. O. G. Cunningham of Kansas City, Missouri. In a few words, Dr. Cunningham believes in placing the ailing patients in various compartments in this long tubular comprest air steel hospital, where each patient has a different air pressure applied to their body, depending upon the particular ailment from which they are suffering.

The original steel tunnel comprising the comprest air sanitarium as designed by Dr. Cunningham measured 88 feet in length by 10 feet in diameter. This steel chamber is located outdoors, and the interior of the model now in use, is fitted with sleeping compartments, after the fashion of the standard railway sleeping coach sufficient to accommodate 72 patients.

The length of the comprest air treatment which is applied to the whole body varies from three to twelve hours daily and the pressure applied to the patient varies from 5 to 20 pounds per square inch above atmospheric pressure, which is approximately 15 pounds per square inch as we know.

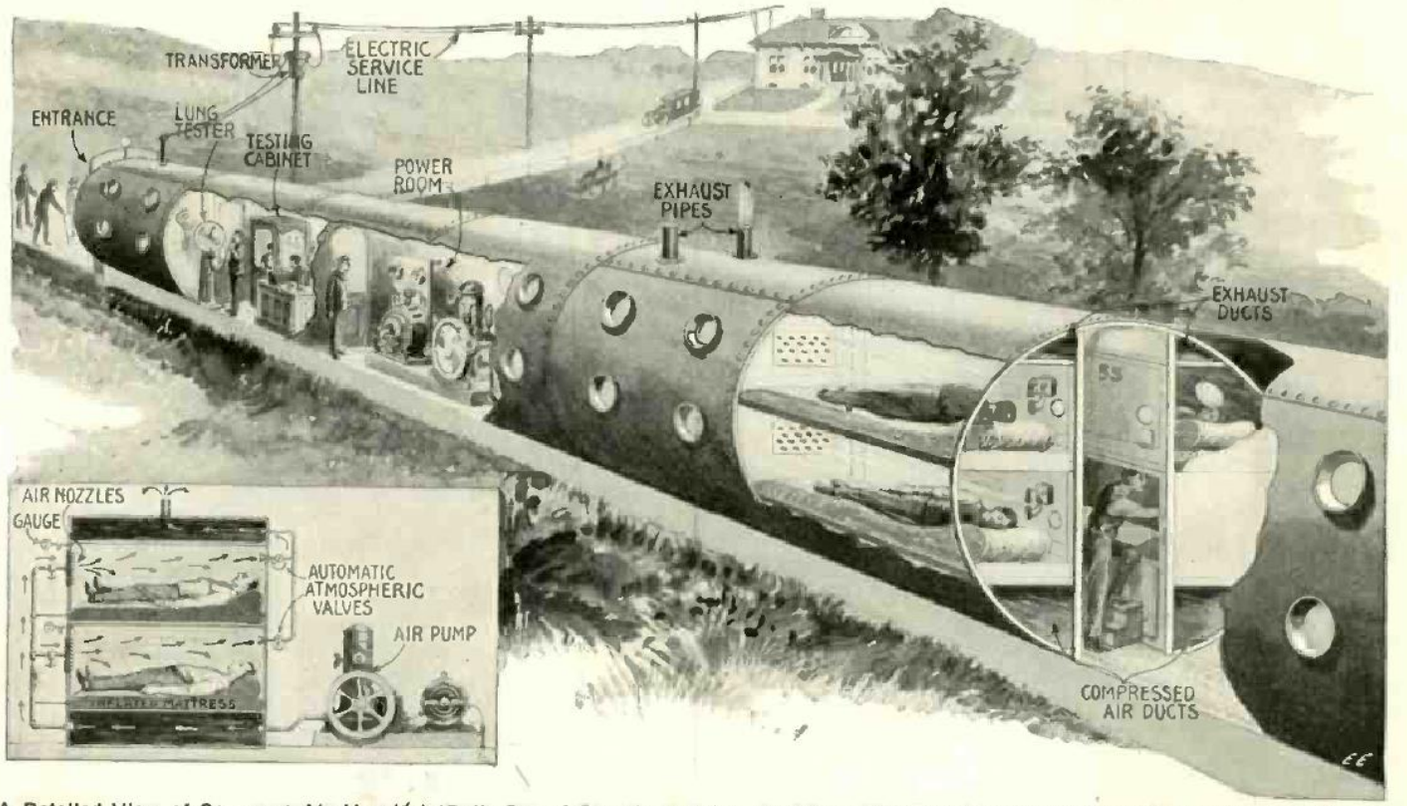
Some of the interesting effects claimed for this radical and promising treatment for human ailments are a distinct and very noticeable stimulation of bodily energy, a general quietude of the nerves, an increase of appetite, and together with this very desirable remedial feature there is obtained restful sleep for the patient.

HOW THE INTERIOR OF THE COMPREST AIR HOSPITAL IS ARRANGED.

The accompanying illustration shows a more fully developt arrangement and layout of Dr. Cunningham's comprest air sanitarium, which is somewhat larger than the 88-foot model now in use. There are many features, however small, among these being a scheme of using round glass port holes, the same as on shipboard, which provide light for the various berths or sleeping compartments, etc.

As will be seen, the length of the tubular chamber is divided off into several of these compartments, the majority of these comprising treatment chambers for the patients.

(*Continued on page* 313)



A Detailed View of Comprest Air Hospital (Built Out-of-Doors), showing the Three Different Divisions Contained Therein, viz.: One for the Physician's Offices, Where Patients Are Examined; the Second for the Power Room, Where Comprest Air Is Generated; and the Third Division, which Provides Separate Sleeping Compartments for Each Patient. It Is Claimed This Comprest Air Treatment Is Far More Beneficial than Some of the Present-day Treatments Employing the Use of Medicines and Drugs.

New Suspended Monorailway

WE have become so accustomed to see railroad trains, electric street cars, and elevated trains travel along on top of their rolling wheels,—that it comes almost as an electric shock to our imagination, perhaps, to consider for the moment, the suspended electric railway such as that shown on our front cover, and in the accompanying photographs.

With the rapidly mounting cost of building electric or other railways and also the higher operating cost from day to day, shortly, perhaps, be served with the very latest development in this unique and novel form of transportation, which is ideally adapted to the efficient movement of both passengers and freight.

Two of the accompanying photographs present views of the oldest suspended electric railway in the world, that of the Langen type operated at Elberfeld, Germany, known as the Barmen-Elberfeld Monorailway, which has been in operation over its 8½ mile run, since March, 1901, or nearly 20 years. This line has proven very successful and cheaper than any other form of transportation in its lengthy period of operation. This line is now carrying about 10,000,000 passengers every year, and it has carried a total of well over 150,000,000 passengers, with not a single passenger or employee injured or killed during the entire extent of its operation.

possest by this system of railroading which are not to be found in any other form of rail transportation. Among the advantages of particular prominence, we find:

1: A medium weight train can be operated at high speed over the suspended monorail system with the same stability as at present obtainable only by the use of very heavy trains with their low center of gravity. The big point here, is that with our heavy trains, we continually need more horse-power to move them, and more speed means more weight. This is not the case with the suspended monorail train, it being possible to operate it at from 70 to 80 miles an hour with only medium weight in the cars, necessitating, therefore, only a fair amount of horse-power in the electric motors to propel the trains.

It may be said here, that the system of propulsion is very simple, the electric current being taken from a so-called third-rail, which is nothing but an insulated bare electric conductor, mounted either on top or at the side of the steel I-beam track, on which

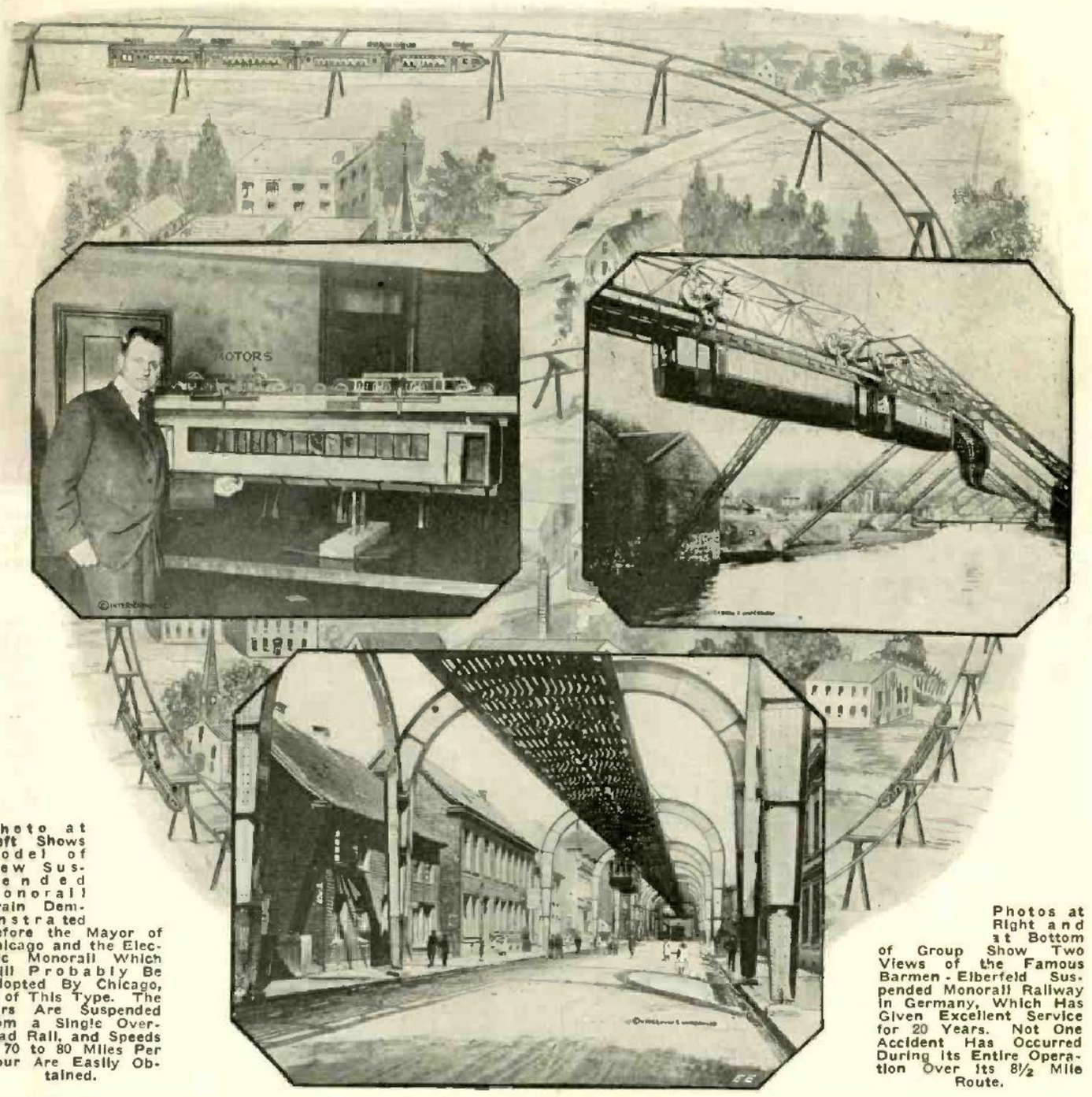


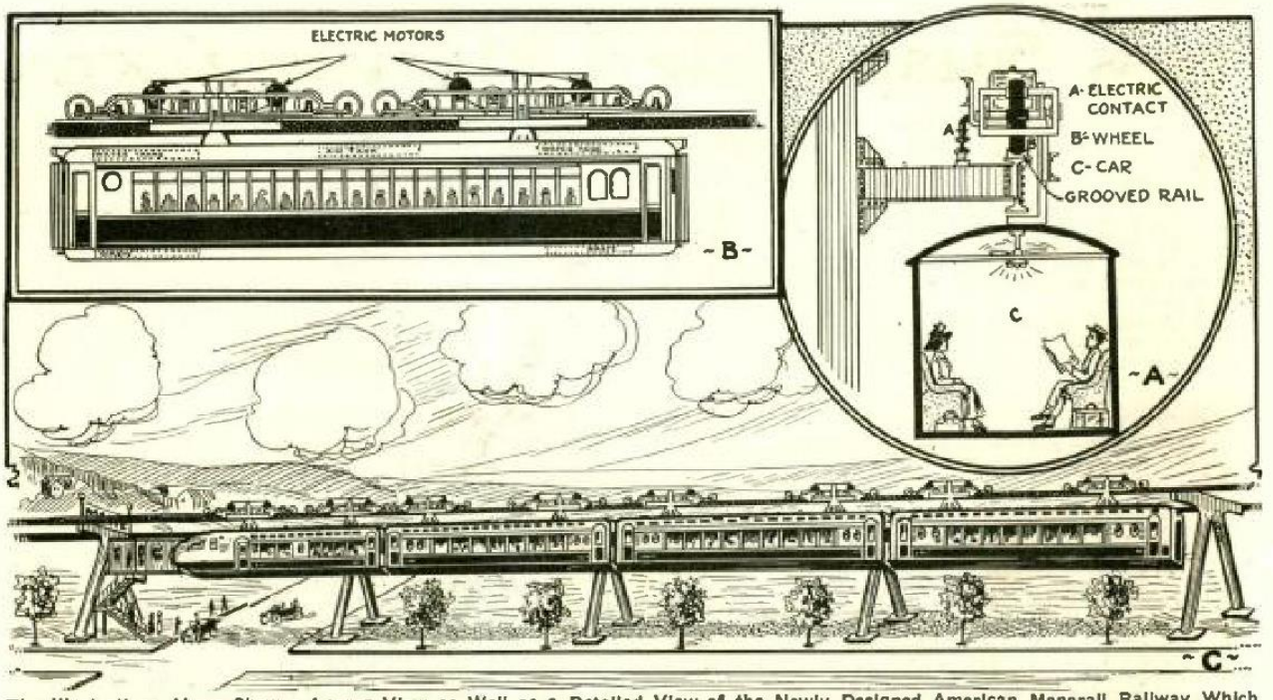
Photo at Left Shows Model of New Suspended Monorail Train Demonstrated Before the Mayor of Chicago and the Electric Monorail Which Will Probably Be Adopted By Chicago, Is of This Type. The Cars Are Suspended from a Single Overhead Rail, and Speeds of 70 to 80 Miles Per Hour Are Easily Obtained.

Photos at Right and at Bottom of Group Show Two Views of the Famous Barmen-Elberfeld Suspended Monorail Railway in Germany, Which Has Given Excellent Service for 20 Years. Not One Accident Has Occurred During Its Entire Operation Over Its 8½ Mile Route.

American engineers who have been endeavoring to solve some of the tremendous traffic problems of the great city of Chicago—the "Gate-Way to the West"—have found the advantages of the electric monorail, with suspended cars as here shown, worthy of their most earnest consideration. The photographs herewith show in a vivid manner, just why the monorail of this type has made such an impression on American engineers; in fact so much so, that the city of Chicago and its environs will very

OUTSTANDING FEATURES

Looking at the accompanying photograph, one will see that there are indeed a great number of revolutionary features



The Illustrations Above Show a Larger View as Well as a Detailed View of the Newly Designed American Monorail Railway Which It is Proposed to Adapt in Chicago and Environs to Help Relieve the Severe Traffic Congestion in Chicago. Instead of Using Grooved Wheels on Which to Suspend the Cars, Crowned Wheels Travel Along in Circular Grooves on Top of the Rail Beam. The Arrangement of the Third Rail and Contact Shoe is Also Clearly Shown.

the wheels carrying the weight of the suspended cars travel.

In the newly proposed American form of suspended monorail, the wheels from which the cars hang, instead of being fitted with a flange as in the Langen or foreign system, are designed to travel in a deep circular groove, formed in the rail on top of the I-beam track structure, as one of the accompanying illustrations clearly shows. This illustration also shows the arrangement of the third-rail shoe thru which the current is taken, and after passing thru the motors, it then flows thru another wire and out thru the wheels to the rail on which the cars are suspended, and back again to the power house.

2: The second big feature of the suspended monorailway is that there are no *grade crossings*, and also with the highly perfected electric interlocking block system now used, improved signals, etc., there is practically no danger whatever from rear-end collisions or head-on collisions between trains on this system.

3: Due to the peculiar mechanical features involved in this system, the cost of giant bridges crossing rivers, chasms, etc., is reduced to one-half or one-quarter the usual cost. Instead of erecting a massive bridge containing perhaps 1,000 tons of steel with wood flooring and cross ties, etc., all that is required to carry the monorail trains over a considerable span of river or chasm is a single, well-supported steel girder, as our front cover shows.

On the average run along land, the columns supporting the monorail track would be placed about 100 feet apart.

4: The maintenance cost of the suspended monorail is only about 25% of what it is on our steam and electric railways and the operating expense can probably be reduced to about 50% of the present value, in order to handle the same amount of traffic, either passenger or freight. It is also figured that about 25% of the present accidents, which are always a large expense conundrum for railroad lawyers to settle annually, will be eliminated entirely by the beautiful simplicity of the suspended monorail train, as it speeds along with airplane velocity over country roads, brooks and even cities, as in Germany.

5: Snow, washouts, or other forms of natural impediments which arise now and then to interfere with the operation of both steam and electric railway trains, as well as street cars or trolleys, do not affect the monorail of the type here illustrated. They hold no terrors whatever for the flying monorail train as it speeds along over the snow banks.

SUSPENDED MONORAIL TRAINS OPERATE SMOOTHLY AT HIGH SPEED

In the Barmen-Elberfeld Monorailway, the trains operate at speeds varying from 22 to 35 miles per hour, but in the newly proposed American system, such as that which Chicago is contemplating installing in order to relieve the severe traffic conditions now prevailing, the speed, at least on suburban runs where the train is given a chance to gain headway, may easily be raised from 70 to 80 miles per hour.

Engineers who have investigated both the Langen and the proposed American system believe that these higher speeds could be reached not only with very safe running conditions as regards curves (and hy the way, these trains do not have to slow down on curves at all), but also these suspended trains could be speeded up to these higher velocities at a reasonable and highly efficient operating cost. This is directly the opposite with the modern steam and electric railway systems such as we have in operation today, as when speeds of 80 miles an hour are desired, we obtain these velocities only by utilizing extra heavy locomotives and coaches, which become quite necessary in order to cause the train to hold itself on the rails and also to aid in giving it a low center of gravity.

The law of design of the modern steam engine gives the key to this situation at a glance. If you want a certain traction exerted between the driving wheels and the rails then what you get, is a certain percentage or about one-fifth or 20 per cent. of the load placed on the engine drivers. Thus, with a 600,000 H.P. engine, a traction of about over 80,000 to 100,000 pounds may be attained. With the monorail, all the weight is centered on the overhead wheels, and as can be readily seen, even by the lay man, this downward tractive effort is high indeed, which obviates any extra loading of *useless, dead weight*, as is the case with our modern railway systems, into the railway cars and engines in order to obtain the necessary stability at high speeds.

DETAILS OF ROLLING STOCK

One of the accompanying photographs shows a model of the proposed American type of suspended monorail cars, as demonstrated before the Mayor of Chicago and engineers connected with the city government.

As will be seen, the track and wheel arrangement on top of the car by means of which the passenger carrying compartment is suspended, is entirely different from the German type. Instead of having but two wheels driven by an electric motor as in the Langen type of car, the new model involves the use of a series of wheels,—six on each truck in the present case, the advantage of this arrangement being, as the engineers have pointed out, that the load is more evenly distributed over a track span, equal to the length of the car itself.

In other words, the two trucks with their 12 wheels for each car, will be distributed over as great a length approximately as the car itself. This works out advantageously in many ways, and it is one of the big items that reduces the estimated cost of the American system to less than one-half that of the Langen system. This is so because there is much less steel required in the rail structure for one thing. Again, there is a markedly greater traction manifested between the wheels and the rail, with a consequent greater grade climbing ability, than is the case where but two wheels or even four for the car, is used, as in the Elberfeld railway.

Of course, the cars are fitted with Westinghouse air brakes and all the other niceties of modern electric railroading.

The coaches for this class of service are constructed of steel and are to be just as comfortable and luxuriously furnisht as the best cars operated by the steam railroads. It is understood that in the German system there is considerable noise at times, especially when the cars run around sharp curves, due to a "squealing" of the wheels, but in the American system this slight objection, as we might really call it, is to be eliminated, as these trains *operate entirely noiselessly*.

This Rubber Clock Will Stand All Kinds of Knocks and Falls. Great for Travelers.

chinery, in automobiles, motor boats, trains, airplanes, etc., and in fact can be used to advantage any place where vibration and shock would deter the accuracy of the ordinary time-piece.—ROSE HARRIS.

The Old Panama Hat is Dampened and Ironed, and its Pristine Shape is Brought Back in Jig Time—Thanks to the Electric Iron. Photo by Edna Purdy.

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Whole No. 94

Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

FEBRUARY
1921
No. 10

A Floating City

WE illustrate an interesting suggestion from a German contemporary, which the editor thereof terms a "Utopia of Karl Ammon," who probably got his idea from Jules Verne's "Floating City." The point is made that in the development of airplanes and dirigibles, great advances have been made in the art of producing light structures which at the same time are strong. This lightness is in the very essence of airplanes and dirigibles, and now in the present project, it is proposed to apply it to the development of a new mode of sea transport.

Four ships, each larger than the "Imperator" are decked in and provide simply room for the working crews for the machinery and for the motive power, and for some or all of the requisite fuel. Thru the body of each ship, starting at the deck, there is an inverted funnel-shaped structure, at whose apex near the keel, is a steel hemisphere forming one member of a massive ball and socket joint. A great platform or deck over fifteen hundred feet square, is carried by the four ships, the entire weight of the great structure resting on the four ball and socket bearings within the four ships.

An auxiliary thrust strut is used to keep each pair of ships parallel. The result of all this is that the great platform will have very little motion in the heaviest sea way; the bearings on which it rest are in the part of the ship where the motion is the least and its length of side will also operate to minimize the motion.

On the deck, the imagination of the inventor exercises itself in the construction of hotels and other structures which may be accommodated on so large an area. It will be noticed that it is practically one-third of a mile square. Houses, shops, bathing establishments, theatres, a wireless station and the local telephone service are all supposed to be supplied, and there is to be a printing press to publish a daily paper and special announcements.

In short the proposer wishes to construct an actual *floating city*. Naturally it is claimed that there will be no sea sickness, altho one is free to doubt this. It is said that the traveler will no longer have the feeling of confinement to a small area, but that he or she can spend hours walking about the great deck, which it is claimed will take half an hour to walk around. The mere view of the raging sea from this practically motionless platform high above it will be a wonderful sight it is said.

Of course provision is made for any quantity of freight, automobiles and the like. Out of the funnel-shaped opening in each ship rises a great steel pillar and to this the trusses of the superstructure are secured. All the motion of the platform therefore that arises from the ship is the comparatively slight up and down

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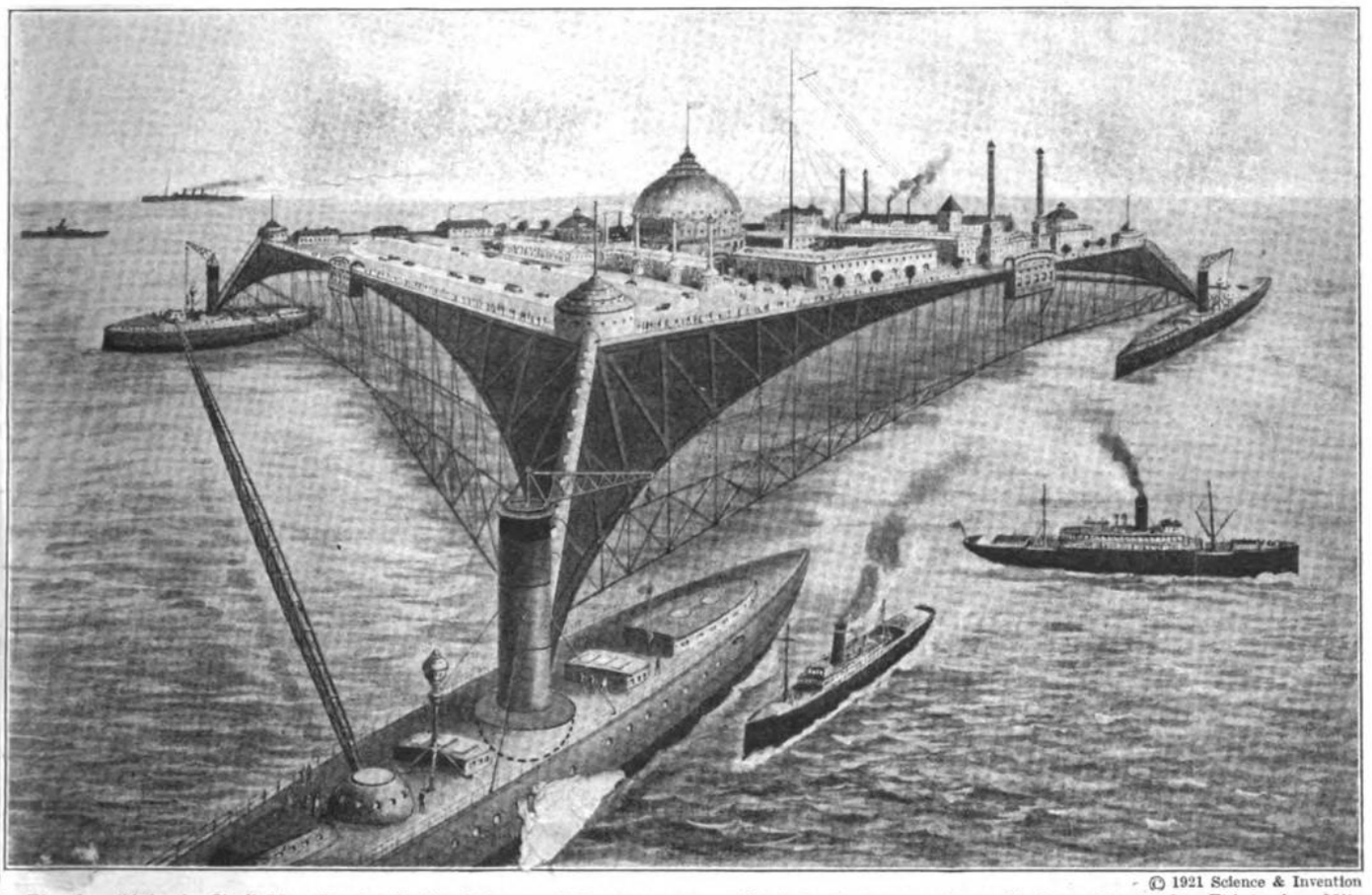

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A Floating "Atlantic City" May Be the Realized Dream of Tomorrow. The "City" Is Built on a Huge Platform Nearly One-Third of a Mile Square and Supported by Four Giant Steamships. The Supporting Towers Are Flexibly Mounted in the Holds of the Vessels.

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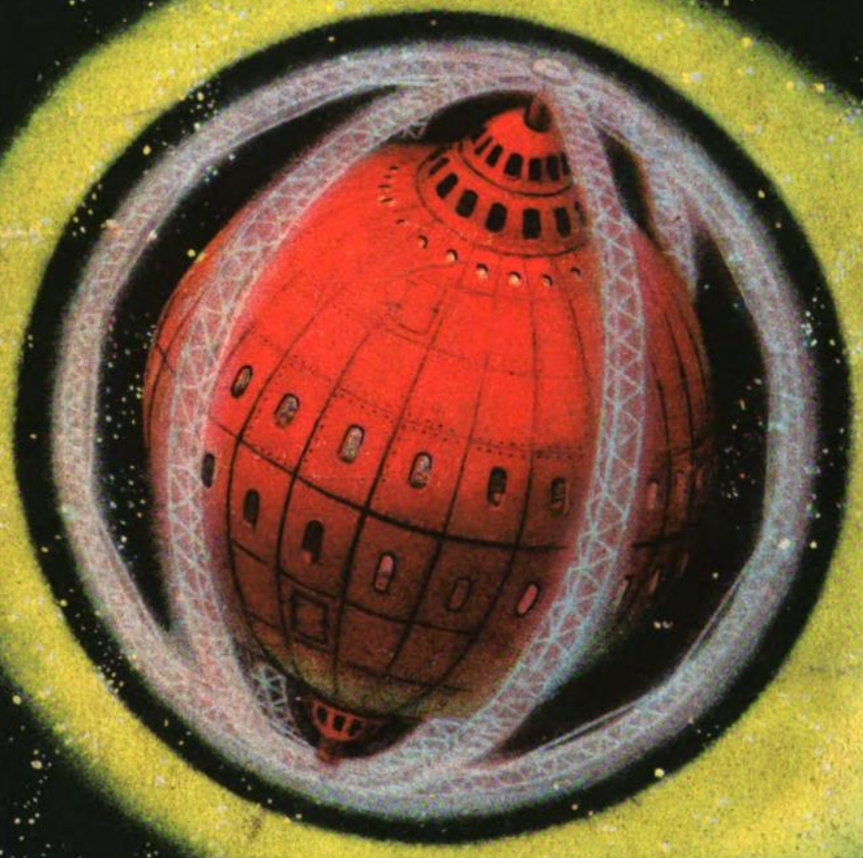
CAN WE VISIT THE PLANETS?

See Page 1290



HOWARD BROWN

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H. GERNSBACK,- EDITOR
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T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

APRIL
1921
No. 12

200-Mile-Per-Hour Air-Propelled Railway

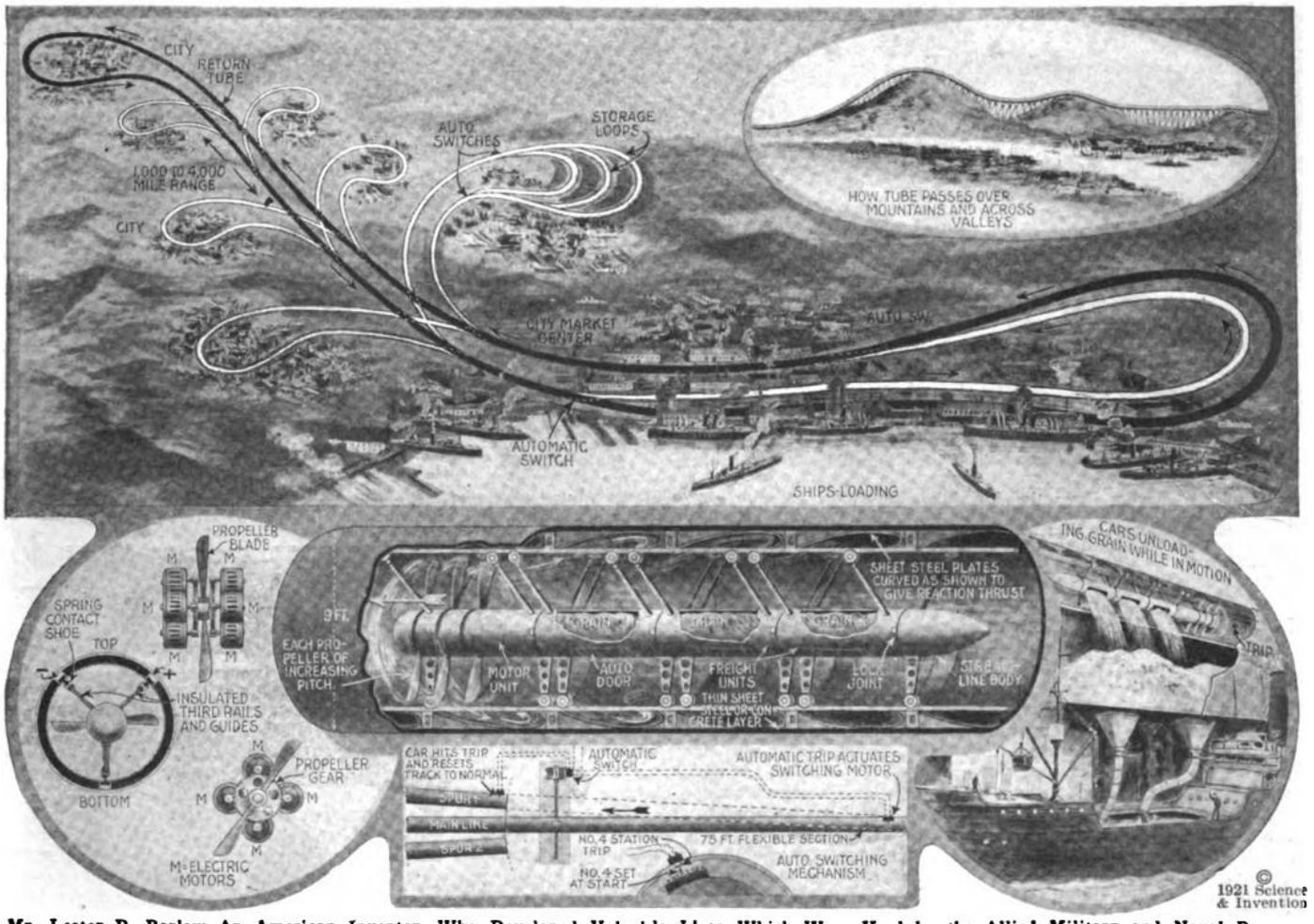
SEVERAL years ago, a Russian engineer and genius who was visiting the United States, proposed a remarkable scheme for carrying passengers as well as freight, mail and other matter thru a tubular railway system at velocities of 200 miles an hour and more, but the principal disadvantage of his system was that it was supposed to operate by a vacuum, i.e., the tubes were to be exhausted of air. Such a system as this would seem to our practical minded engineers, as being really too elaborate both from the operating as well as the constructional cost point of view.

An American inventor, Lester P. Barlow, who devised many ingenious devices successfully applied in the World War, and which helped the Allies to conquer the power of the Teutonic forces, has come forward with what appears to be a very clever invention for carrying mail and other material between different sections of the largest cities as well as between such cities as New York, Chicago, New Orleans, St. Louis, Philadelphia, etc.

In a few words, what Mr. Barlow intends to do, is to provide a steel tube, which need not be air-tight, and thru which a series of carriers or cars will shoot along at a speed of 200 miles or more per hour, being forced thru the tube at this high velocity by means of an aerial propeller or a series of three such propellers, mounted a short distance apart on the forward end of the engine unit of the train as shown.

These propellers are driven by electric motors, the motors receiving their electrical energy thru two insulated power rails as shown in the diagram in the accompanying illustration. The bottom rail is the main carrier member and takes the

(*Continued on page* 1340)



Mr. Lester P. Barlow An American Inventor, Who Developed Valuable Ideas Which Were Used by the Allied Military and Naval Powers During the World War, Has Turned His Talents Towards Peace-Time Uses, and Here Suggests a Remarkable Air-Propelled Railway, the Cars of Which Are to Be Propelled by Air Screws Similar to Those of Airplanes, At a Speed of 200 Miles An Hour or Greater. The View At the Top of the Illustration Shows How the Light Steel Tube Might, for Example, Connect the Principal Cities Along the Mississippi Valley From Chicago to New Orleans, Enabling Grain and Other Commodities to Be Automatically Transported Between Cities or Between the Great Lake Ports At the North and the Famous Gulf Port At the South With a Maximum of Speed and a Minimum of Labor. As the Detailed Drawings Show, the Cars Are Much Smaller Than the Tube So As to Provide Space for the Air Currents. The Cars Are Propelled by Electric Motors, the Current Being Fed to These Motors by Two Insulated Rails and Suitable Contact Shoes. Mr. Barlow Has Worked Out Details Whereby the Cars or Carriers Can Discharge Their Cargoes, While They Are Still in Motion, As Shown At the Left.

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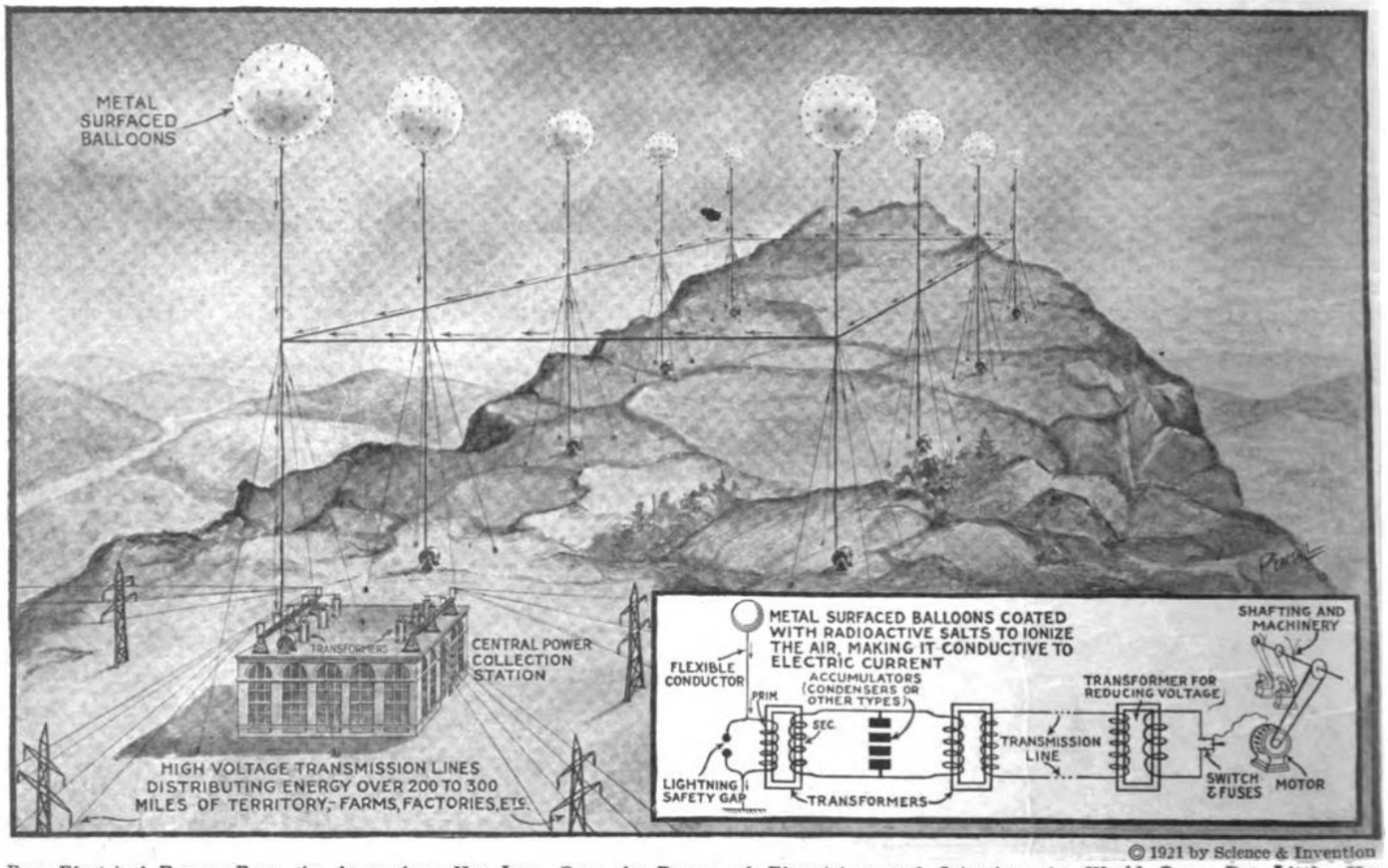
ıectric Power From the Air

THE utilization of free electrical energy in the atmosphere surrounding our earth, has proven the magic goal towards which inventors have striven for several generations; but until recently there has been practically no headway made toward reaching the desired result—the obtaining of power from the air for economic uses. putting to work this free energy of the atmosphere. It is said that he has successfully demonstrated that if we send up metal-surfaced balloons or other surfaces and tap the atmospheric electrical energy, at elevations in excess of 1,000 feet, we shall be able to realize an average of 200 horse-power per square meter, which area is equivalent to 10.8 square feet. It is winter weather, the potential gradient often rises to as high as 300 volts per meter. This may seem somewhat hazy and in fact almost impossible of belief to the average person, and there are two reasons why we do not notice this startling difference of potential for every meter increase as we are elevated. One of these is that the electrical energy is



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Free Electrical Energy From the Atmosphere Has Long Been the Dream of Electricians and Scientists the World Over, But Little Has Been Done Up Until the Present Time in Trying to Adapt the Tremendous Quantities of Free Electrical Energy Existing in the Atmosphere to the Everyday Utilitarian Requirements of Mankind. The Present Article Deals With Some Recent Experiments Carried Out by Dr. Plauson, a German Engineer, Which Have Shown Some Very Interesting Results. It Is Said That This Scientist Has Successfully Demonstrated, That If We Send Up Metal-Surfaced Balloons and Tap the Electrical Energy From the Atmosphere At a Level of 1000 Feet or More, We Shall Be Able to Realize an Average of 200 H. P. Per Square Meter, an Area Equivalent to 10.8 Square Feet.

In the early days of electric lighting, that is, back in the 70's and 80's, there were a number of scientific experiments carried out which received a great deal of publicity at the time, and whose recitals described how in the immediate future we would undoubtedly obtain our electrical energy for lighting and power purposes, from the atmosphere. But, as aforementioned, there has been practically nothing done in this direction until the present time, and there is a very good reason why but little has been done by scientific investigators and electricians in endeavoring to harness the natural electrical forces of nature, as resident in the atmosphere, for the everyday utilitarian requirements of mankind. This reason lies in the fact that the electrical power of nature, particularly when so-called thunder or electric storms hover above us, are not to be trifled with.

Recently there have appeared in a German publication, some notes on the new discoveries and experiments of a German scientist residing at Hamburg,—one named Plauson. Plauson has studied the subject of atmospheric electricity and its utilization for many years, and he has recently come forward with a clever scheme for

even claimed that in his latest experiments, as great a quantity of electrical energy as 400 to 500 horse-power has been realized per square meter.

The atmosphere or air above the earth's surface, in normal weather, is charged with electricity, thus constituting an electrostatic field which is almost uniform and in which the surfaces of equal potential are parallel to the earth, or in which the lines of force are vertical. In the event of violent atmospheric disturbances such as before or after, and of course, during the course of electric storms, the atmospheric potential fluctuates and changes in polarity very markedly, as careful scientific investigation and measurements carried out in various parts of the world, have demonstrated.

Under normal weather and atmospheric conditions, the potential gradient, as it is called, of the atmosphere increases with comparative regularity as we rise above the surface of the ground. The atmospheric potential per foot or meter of altitude varies also, as may be well imagined, with the season of the year, and this potential or voltage has been found to average 100 volts per meter (3.28 feet) in the summer months, while during the cold

mostly in the form of high voltage static electricity, but of small quantity, similar to that given off from large static machines. If you have ever stood under the discharge terminal of one of these machines and felt the *electric breeze* which sometimes causes the hair to stand vertically from the head owing to the very high voltage (but relatively small amperage or current present), the emf., of which may easily have been several hundred thousand volts, you were given a practical demonstration of how the atmosphere may be highly charged electrically and yet be unnoticed by the usual organs of sense.

Another reason why we know nothing of this increase in potential with elevation is that the experimenters usually do not have the proper instruments with which to measure the atmospheric potential, and therefore often lose sight of the fact that in the winter, for example, we may have present an emf. of 100 volts per foot. These high potentials, owing to their static nature, are measured by a very delicate electro-static voltmeter. Those interested in this phase of atmospheric electricity will find descriptions of the apparatus used, as well as results and meas-

(*Continued on page* 1343)

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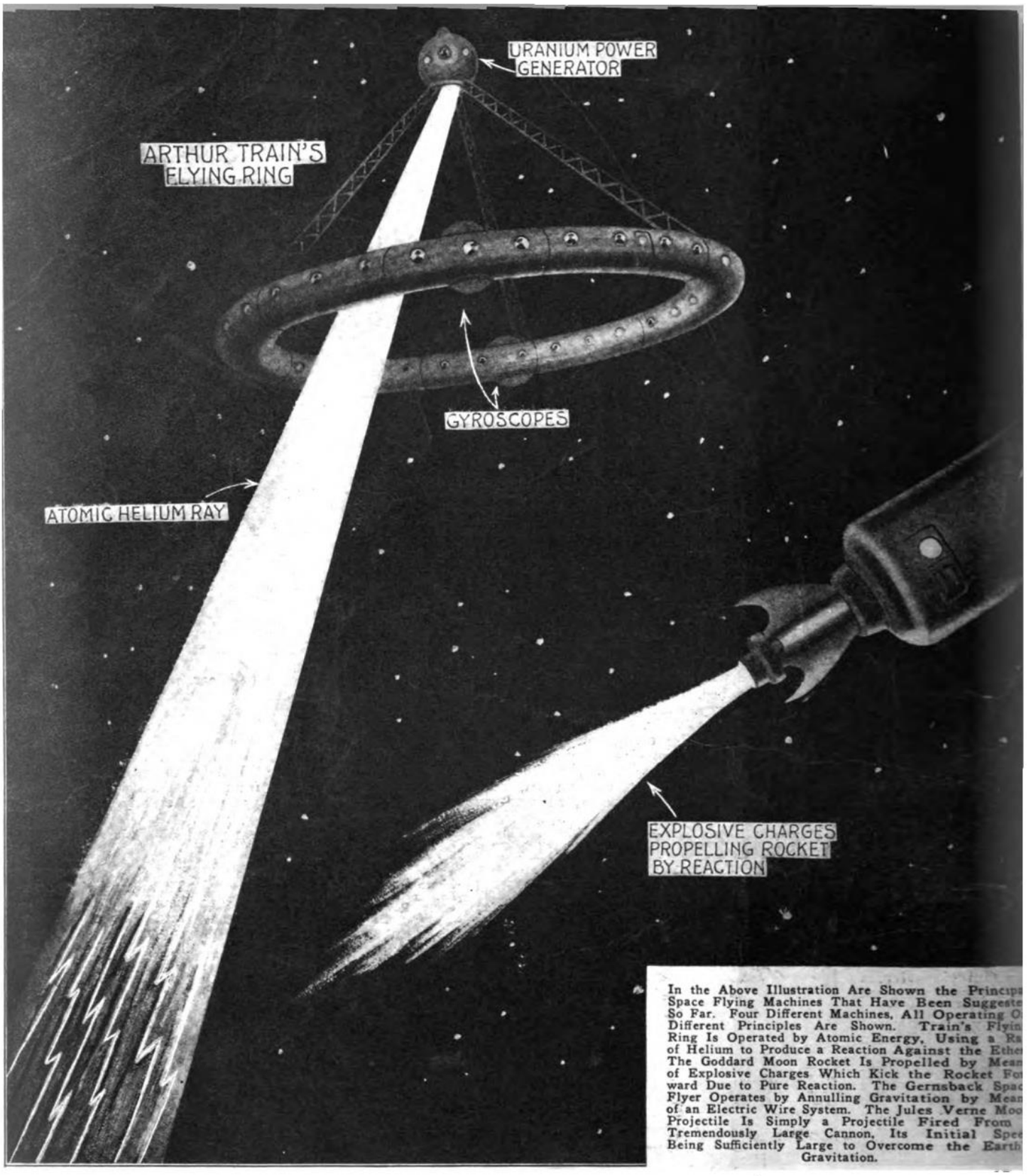

In the Above Illustration Are Shown the Princip Space Flying Machines That Have Been Suggeste So Far. Four Different Machines, All Operating O Different Principles Are Shown. Train's Flyin Ring Is Operated by Atomic Energy, Using a Ra of Helium to Produce a Reaction Against the Ethe The Goddard Moon Rocket Is Propelled by Mean of Explosive Charges Which Kick the Rocket Fo ward Due to Pure Reaction. The Gernsback Spac Flyer Operates by Annulling Gravitation by Mean of an Electric Wire System. The Jules Verne Moo Projectile Is Simply a Projectile Fired From Tremendously Large Cannon, Its Initial Spee Being Sufficiently Large to Overcome the Earth Gravitation.

Flying In Space

By H. GERNSBACK

TWENTY-FIVE years ago mechanical flight was discussed seriously by scientists all over the world. Many scientists of great authority demonstrated mathematically that it was absolutely impossible for a man to fly a machine heavier than air. Eminent men of science sustained this view. Notwithstanding all this, we are flying today at will and we are building airplanes that can rise thousands of feet aloft and transport one hundred people over great distances. As usual our scientists were not correct as to what can or cannot be done.

The next step will be flying not only in the atmosphere, but flying in space where there is nothing to sustain a machine and where propellers and planes are no longer of use, because where there is no air there can be no mechanical flight as we know it today.

The full thickness of the earth's atmosphere is roughly speaking about 500 miles This takes in the densest layer from the earth's surface to the outer space where there is an absolute vacuum, but our atmosphere proper is probably not thicker than

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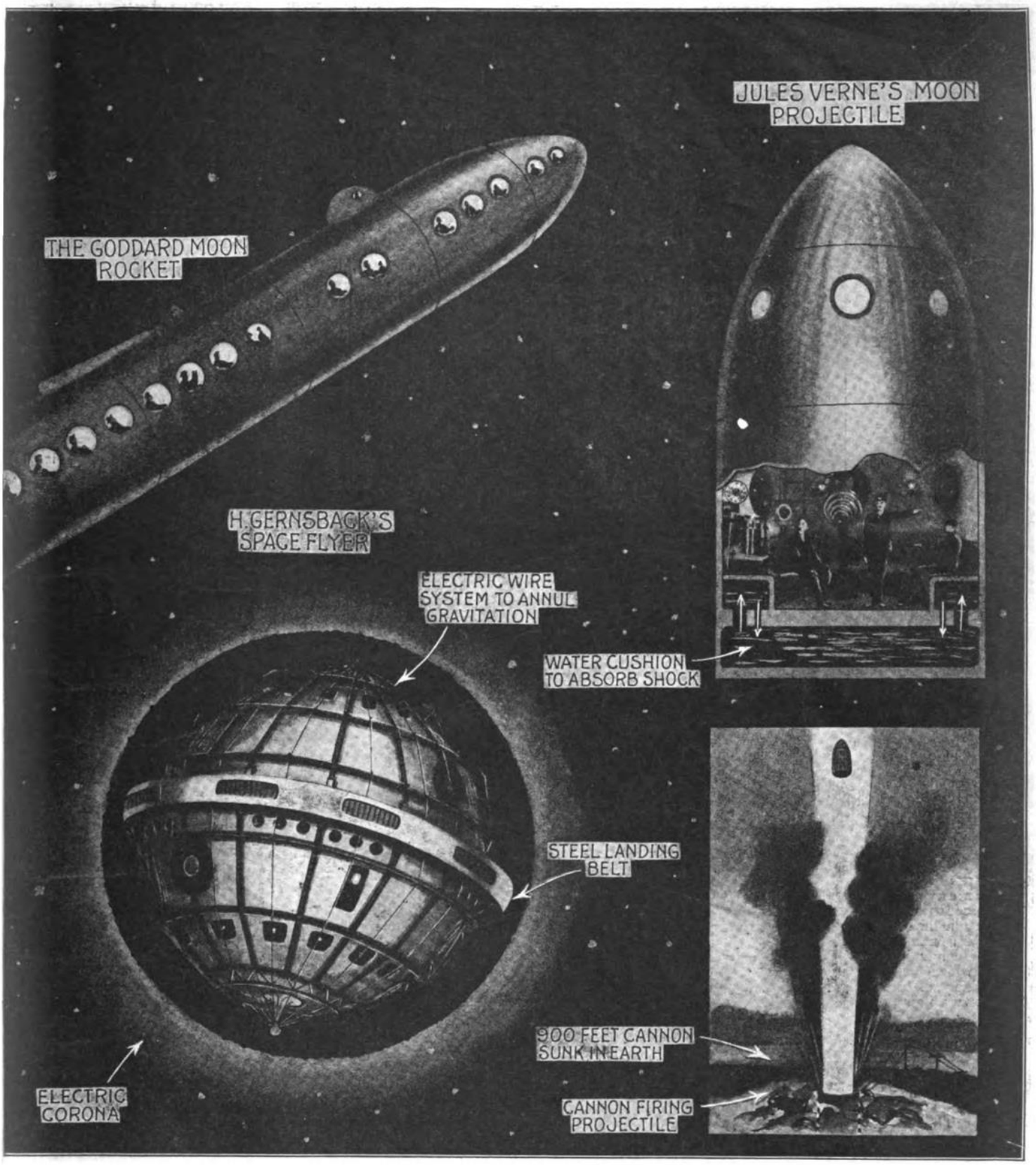

30 miles. After this distance the rarification becomes extreme. All of this, however, should not deter us from attempting to fly in space. To those who say it is impossible for a body to float in space and in vacuum, let them look at the moon or at any of the stellar bodies, and he will find that these bodies indeed float very nicely without any support whatsoever. This is, of course, due to universal gravitation, but for the moment this need not concern us.

How then can we fly in space? There are several vital points that must be considered. The main point is the earth's gravitation that holds all bodies chained to it. Take a balloon for instance. As soon as the gas gives out, the balloon must come down due to the earth's gravitation; the same thing is true of an airplane which falls or must glide down as soon as the propeller stops. If directional flight at will in space ever becomes assured, it will be absolutely necessary that we first master gravitation, or otherwise annul its effects in some way. Just how this can be accomplisht we of course do not know exactly today, altho there have been several attempts made to conquer the baffling forces that hold all objects to the earth.

The writer has stated many times in his past writings that gravitation is conceded to be an electrical effect today. If this is so, then sooner or later we will find a way to counteract gravitational force by electrical reaction, and when this happens, it will be a simple thing for us to build a machine that by means of electricity overcomes gravitation in a similar manner to a railroad engine overcoming friction by furnishing enough power to dispose of the latter. This is what makes a train move.

One of the earliest and now historical methods proposed for a machine to travel into space was the well-known moon projectile invented by the fertile brain of Jules Verne. He imagined a huge cannon sunk 900 feet into the earth. It required 400,000 pounds of gun cotton to fire the 20,000 lb. aluminum projectile which contained three travelers. The details of this invention were described in his well-known book

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"From the Earth to the Moon." Scientifically this idea is absolutely sound, and if we actually would build a cannon as imagined by Jules Verne, and firing a projectile such as he described, the initial force given the projectile would be sufficient to overcome the gravitational pull of the earth and the projectile would leave the earth never to return. This is a condition fully realized by all artillerists. Given a cannon which fires a projectile whose initial speed is 12,000 yards a second, this projectile will fly out into space never to return. The passengers probably would not survive the shock, but that need not concern us here. Of course this idea was purely fanciful, and the great trouble with it is that there is no means of "navigating" such a projectile. Once out in space it becomes subject to various gravitational effects. If it came within the direct influence of the moon, for instance, it would be drawn toward the surface where it would be smashed to pieces in an instant. If, on the other hand, it would not come under the direct influence of a stellar body, it would roam around the universe for all time until finally struck by meteors or some other body.

In 1915 the writer publisht in the June issue of the "Electrical Experimenter" a machine to fly in space and he gave it the name of "Space Flyer," under which name machines of this kind have now become known. The writer's idea was to use a sphere some 75 feet in diameter which contained all the different machinery and apparatus to navigate and operate the flyer. The underlying idea was to have the whole exterior of the machine criss-crost with an electric wire system, similar to a radio station. These wires radiate over the surface of the machine from the two "poles"; the wires are insulated from the metallic shell of the flyer. The proposal was to use an electric current of a peculiar wave action, which was to annul gravitation electrically. The machine was steered very simply by switching in or out various sections of the wire system. For instance, if the machine was to leave the ground all that was necessary was to switch on the wires facing the ground, while the part pointing towards the sky was not to be electrified. A reaction would immediately set in and the machine would naturally rise as there was no gravitation to hold it back. If the machine approached the moon or a planet, the same electric current was brought into play again, and the retarding motion set up so that the flyer would not smash itself against the face of the heavenly body. There was a steel landing belt provided on which the machine was to roll upon landing. This was necessary otherwise the wire system would be destroyed.

Another idea is shown in Arthur Train's "Flying Ring" publisht in 1917 in his book "The Man Who Rocked the Earth." This also was a fanciful machine and was propelled by atomic energy. The flying ring had a sort of tripod mounted upon it and at the top there was a uranium power generator which gave forth a disintegration ray of great power. This ray striking either the earth, atmosphere or the ether in space would naturally set up a reaction, lifting the ring. The direction of the machine was of course controlled by this ray. The flying ring also could be steered sideways by means of gyroscopes contained in the interior. This idea is perfectly feasible if we ever can make use of atomic energy.

The latest newcomer in space flying machines is Dr. Goddard with his now famous moon rocket. We have already described Dr. Goddard's rocket in our Feb. 1920 issue of the "Electrical Experimenter," where the detailed description of the principles can be found. Dr. Goddard's idea is sound and there is no question that it is possible to send such a rocket out into space. If we take the experimental rocket of Dr. Goddard and magnify it so that it can carry a number of people we will get a machine similar to the one shown in our illustration.

The Goddard rocket operates by explosive charges which emerge from the end of the rocket and the propulsion is accomplisht merely by reaction. It makes no difference whether these explosive charges occur in the atmosphere or in free space; the action is always the same. As a matter of fact, in free space and in a vacuum the kicking reaction of the explosive charges will propel such a machine much faster than thru an atmosphere where the air resistance tends to retard it. Not only this, but once the rocket leaves the gravitational influence of the earth, a much smaller explosive charge will propel the rocket at prodigious speed.

The matter of steering such a rocket is not a simple one and must be worked out very carefully. It would be necessary to have outlets for the explosive charges directed away from the machine at right angles, preferably at the lower end and at the bow of the machine. These explosive charges would be imperative whenever it became necessary to steer the machine to the right or to the left, to turn it about, or for landing purposes. It would not be a simple task to control such a machine by means of these charges, and it would be a ticklish business for instance to affect a smooth landing upon the surface of the moon. While of course it is not impossible to accomplish this, the matter of firing the

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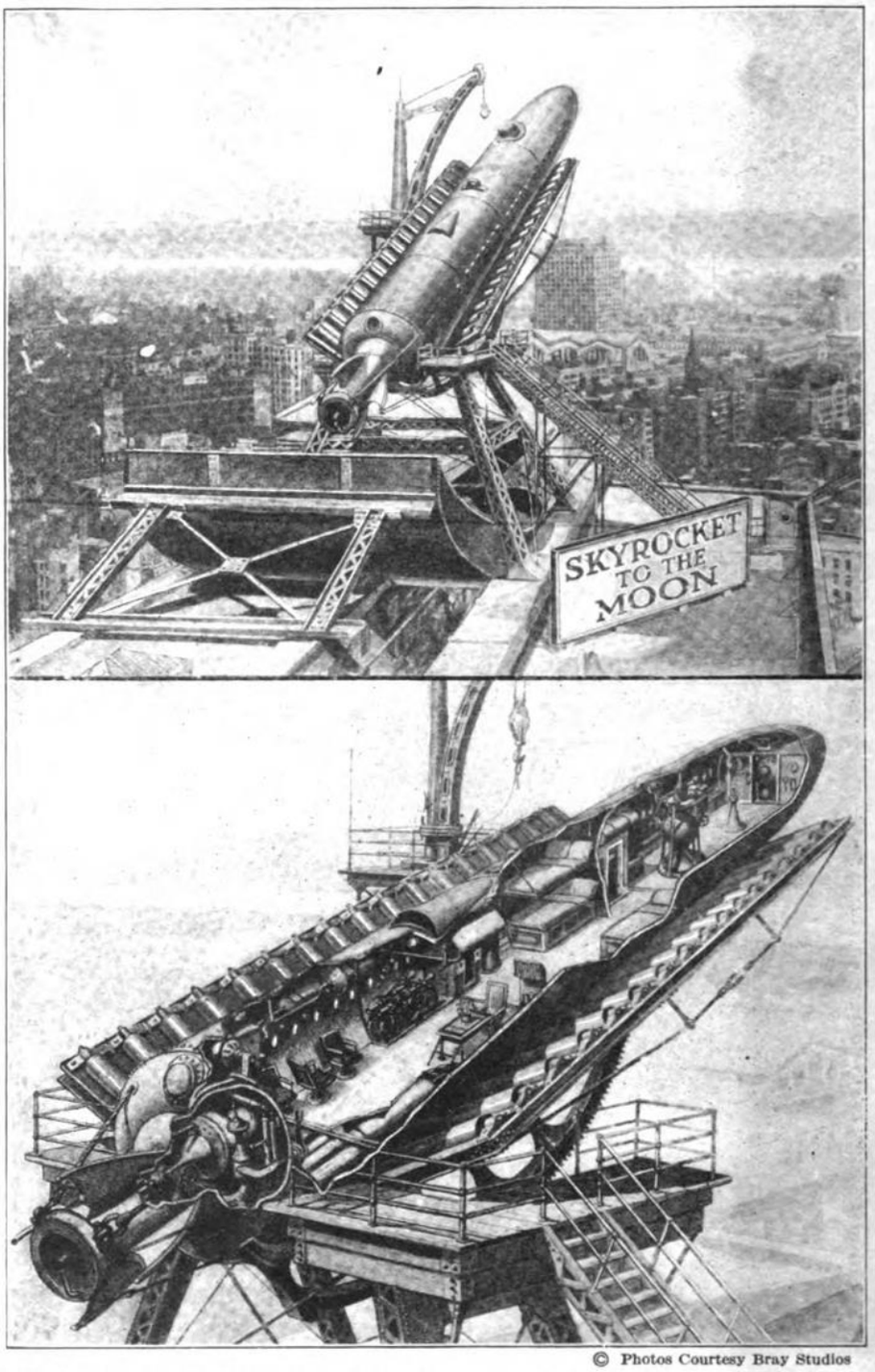

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"All Aboard for the Moon"—May Not Sound So Strange to Our Ears, Fifty Years Hence. Perhaps Even Sooner the Goddard Rocket Will Have Been Perfected and Made Safe Enough to Carry Passengers Across the Intervening Chasm of Interstellar Space to Our Neighbor the Moon. The Interior Arrangement of the Passenger-Carrying Rocket Is Here Illustrated.

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"In 1999"

"Scientific Progress in the Last Century. Presidential Address Before the American Academy of Science, September, 1999."

By FRANKLIN RUTH

Gentlemen of the Academy:

AT the close of this twentieth century we look back upon a more brilliant array of scientific achievements than man has ever been privileged to see, or imagine. within the last few decades our earth has entered upon an era that surpasses the greatest expectations of the nineteenth century philosophers. Civilization has advanced at a rate comparable to a geometric progression, and today we are living in the Golden Age of Science. In looking back upon this century, we should review some of the most significant achievements of the past, and note their bearing upon progress and their relevance to the science of today.

The dawn of modern science occurred in 1898, when the discovery of radium and its radioactive properties was made by the Curie's. The importance of this discovery can never be too greatly emphasized, for it marks the actual conception and birth of the principles upon which today's science is founded. The untiring investigations of those great pioneers of modern science, Rutherford and Soddy, in the field of radioactivity, soon caused them to announce the hypotheses of atomic disintegration and evolution of the elements. Altho these theories were at first discredited and regarded in the same light as Perpetual Motion, the undeniable existence of enormous reservoirs of energy in the minute atom, as evidenced by radium, soon attracted the attention not only of scientific circles, but of the whole world. Discovery followed discovery. Research became busy with the momentous question whether artificial means could accelerate or retard the processes of spontaneous disintegration. Civilized nations became excited and expectant. Vivid fiction, exploiting the imaginary results of the discovery of atomic disintegration, was widely read, and increased the credulity of the people.

It was at about this period that the Great War occurred. Altho this world disaster took a great toll of life, it proved to be an impetus to scientific advancement. At the close of the War the United States found itself the creditor of almost the entire European continent, whose nations were on the verge of bankruptcy and revolution. Unrest was widespread. Crises between labor and capital were imminent. Numerous strikes occurred, and Bolshevik uprisings in Russia threatened to undermine all governmental control and order. The air seemed charged with something that stifled all thoughts of resuming prewar existence. Over all hung unconscious, vague dread, grasped in its entirety by only a few minds of scientific preeminence. Prophets and religious fanatics preached the end of the world and the arrival of the Millennium. The world was ripe for some cataclysm that would overwhelm civilization and possibly sweep all life from the planet.

Suddenly, in 1924, occurred the first phenomenon of a series, which created physical disturbances sufficiently powerful to attract general attention. Scientific investigators, however, with the aid of their delicate instruments, had detected weaker but similar disturbances at previous periodic intervals. The world waited anxiously for words that might come from scientific men, identifying the cause of the mysterious phenomena. Scientists knew that the

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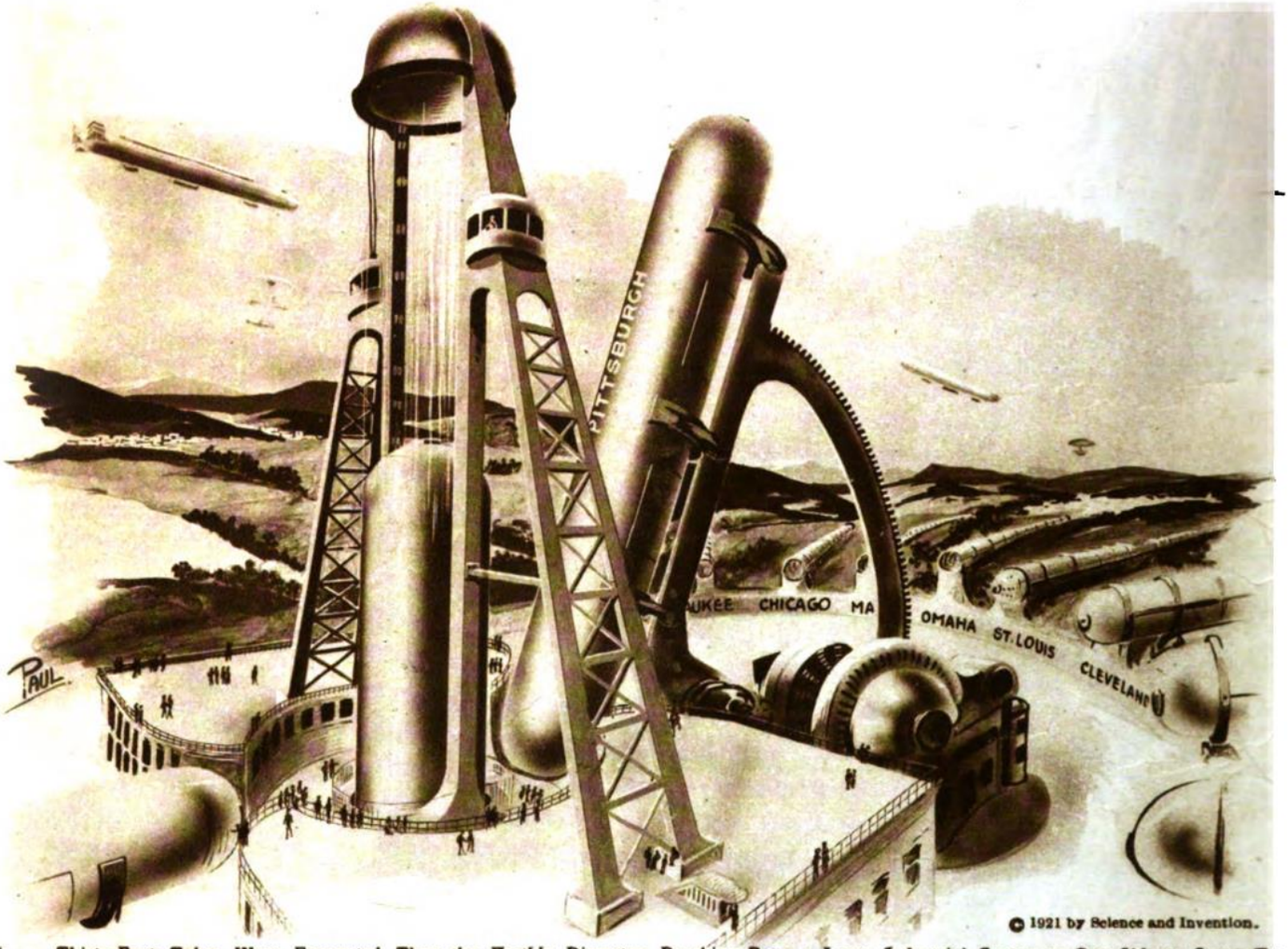

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"..... Thirty-Foot Tubes Were Excavated Thru the Earth's Diameter, Reaching From a Large Industrial Center on One Side to Some Extensive Agricultural Area Upon the Other. Africa, China, Australia and Parts of South America Were Touched. As These Tubes Were Sunk, They Were Lined With Browning's Electro-Heat Converting Apparatus, Which Turned the Intense Heat of the Bowels of the Earth Into An Immense Voltage, Giving An Electric Current, But Left the Interiors of the Tubes Relatively Cool and Insulated From the Fiery Medium Thru Which They Past. Food and Other Commodities Were Then Quickly Hauled Over Extensive Railroad Systems to the Mouths of the Tubes and the Elevator-Like Carriers Were Dropt Thru the Center of the Earth. The Momentum Gained in the 4000-Mile Drop Carried the Cars Past the Center of the Earth and Up to Within a Few Feet of the Opposite Surface. At This Point They Were Caught by Automatic Catches and Giant Electric Hoists Hauled Them to the Surface....."

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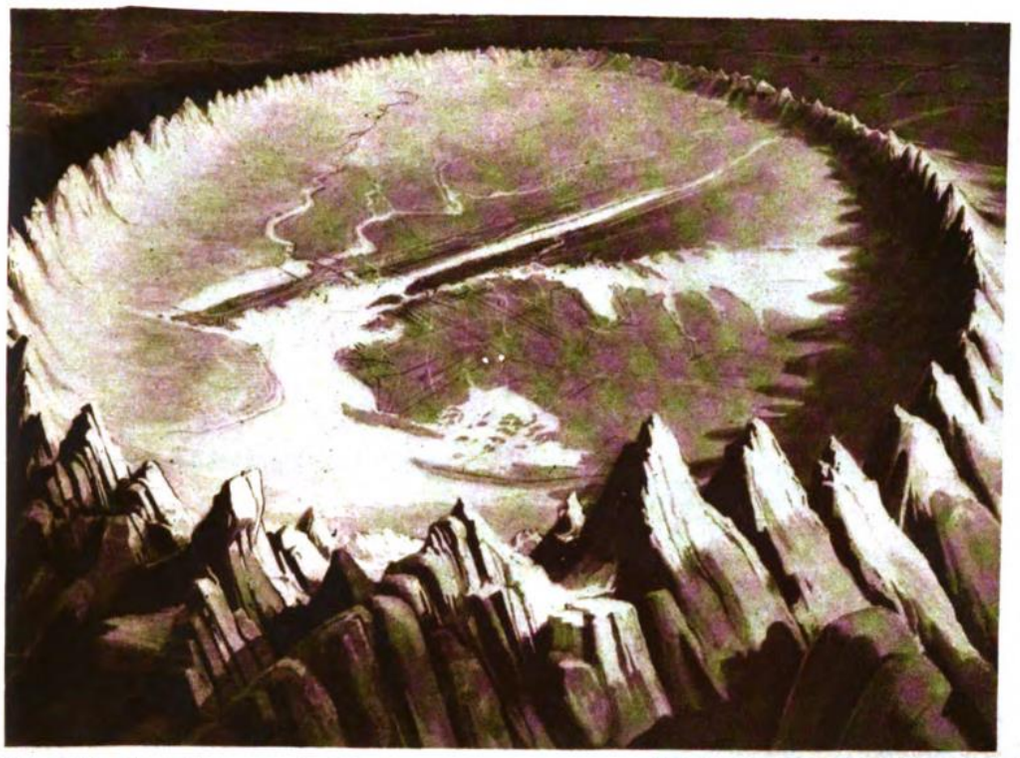

One of the Giant Craters on the Moon's Surface Can Easily Contain the Whole of Greater New York City, as the Illustration Above Shows.

Trip to the Moon

WE know perhaps more of the configuration and physical make-up of the moon's surface than of any other heavenly body, due to our industrious and untiring astronomers. There are few regions of the moon's side facing the earth that have not been carefully explored and charted. Altho the moon is over 238,000 miles distant, our large telescopes bring the lunar landscape sufficiently into range so that all of the larger mountains with their ranges and craters are readily explored. The two illustrations on this page represent lunar scenes as we would see them, if we actually were to visit the moon.

In the first place, the moon, having no atmosphere, the sky as it would be seen from our satellite, is inky black with the stars shining forth in a brilliancy never viewed from the earth. A brilliant sun shines out of a black sky, while the sun itself is surrounded by a wonderful corona with its magnificient streamers only partly seen on earth at the time of an eclipse. Some of the lunar mountain ranges are tremendous, and we have nothing like them on earth. The craters of some of these huge extinct volcanos are of tremendous size; some of them measured across the bottom are more than 150 miles in extent, and you could readily place the state of Rhode Island in one of these huge depressions.

Our top illustration shows only a moderately large size crater, and it will be seen that New York City and environs would readily fit into such a baby crater, having a diameter of some 50 miles. As for height the lunar mountains are truly titanic. Some of these mountains are over 28,000 feet in height. Standing at the foot of one of these giants they seem to topple over on one due to the perspective, the same as when you stand at the foot of a skyscraper and look upwards. It seems to be bending over on you. When the sun shines on these huge mountains, it is of course possible to see all the way up as there is no atmosphere and no clouds to impair the vision. Such a sight must be overpowering and grandiose.

At the foot of these mountains we see huge cracks running in all directions, and these cracks are vast canyons in themselves, much deeper than we know of on earth. They extend for miles down into the bowels of the moon, and a fall into one of them would, of course, mean instant death to the traveler.

But the most impressive and terrorizing experience to the future moon traveler will undoubtedly be the vast death which is on evidence at every hand. The moon is a dead world as we all know, and there are no animals and there is probably no vegetation; only barren rocks greet the eye. Everywhere is silence; everything is dead and lifeless, and the future traveler must be encased in a sort of diver's costume with a glass-windowed helmet as he must bring with him his own air if he wishes to stay alive. And, he does not wish to stay long on the moon unless he walks around the foot of the mountains because there are possibly few places as unsafe as the moon itself. Huge meteors are crashing down almost continuously, and there is no atmosphere as on earth to act as a buffer. These

(*Continued on page* 1355)

Close-up View of the Mountains of the Moon Showing Their Precipitous Sides. The Moon Has No Atmosphere and So Even If an Adventurous Earthly Being Should Make the Trip Some Day, to Our Neighbor the Moon, He Would Not Find It a Very Salubrious or Pleasant Place on Which to Take up His Habitation, for the Only Way He Could Live on the Surface of the Moon Would Be by Providing Himself With an Outfit Similar to that of a Diver's Suit, Equipt With an Oxygen Tank and Artificial Air Device.

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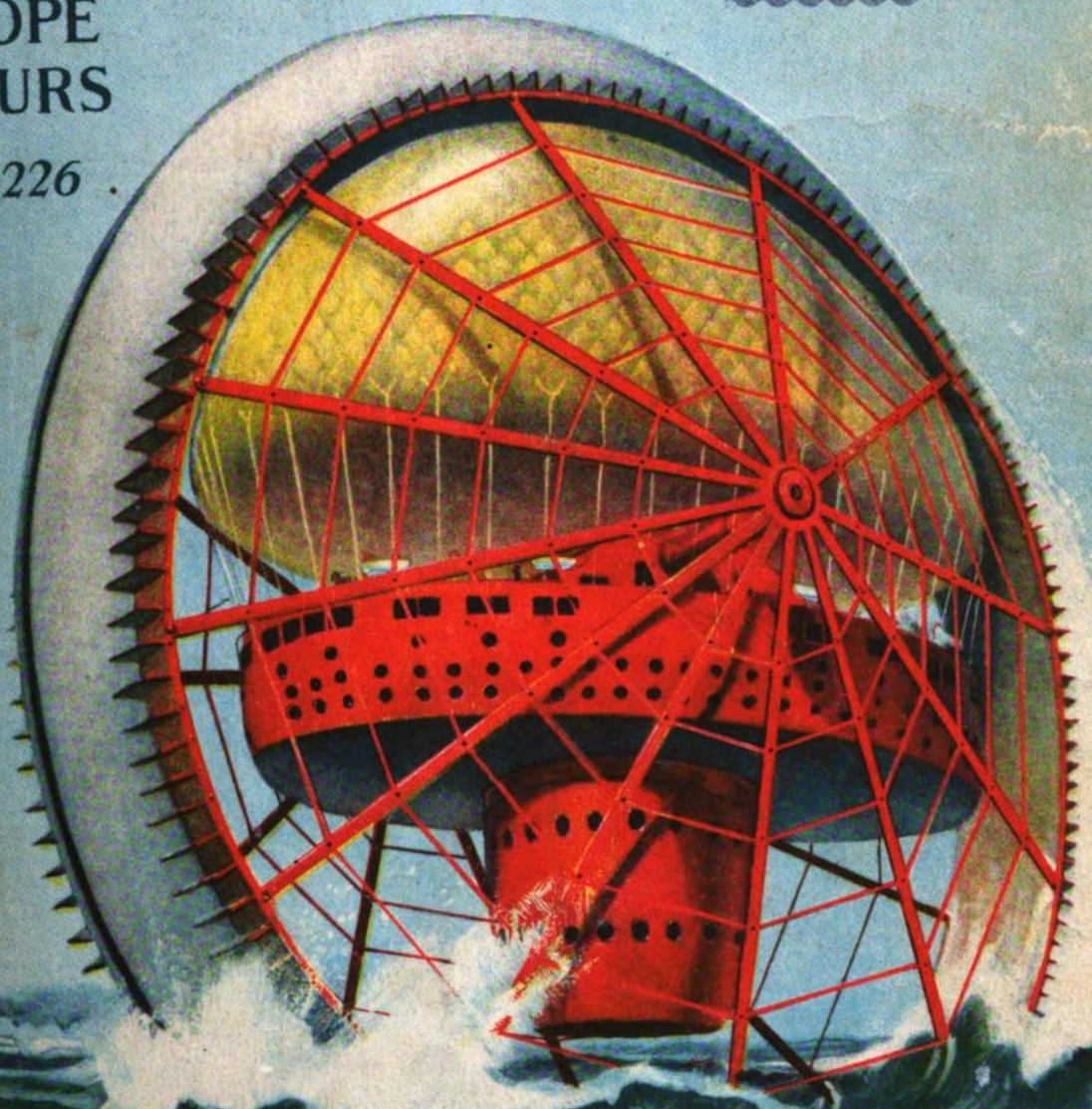

HOWARD V. BROWN

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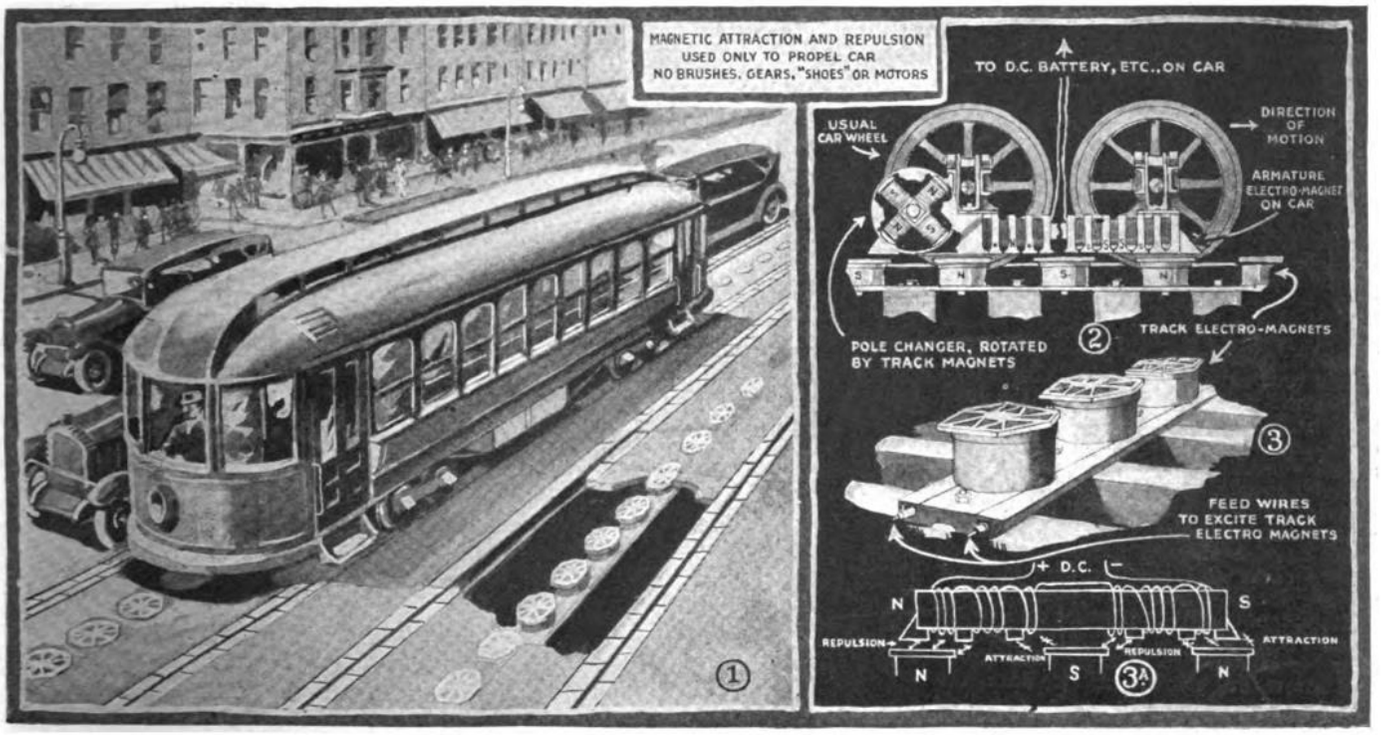
JULY
1921
No. 3

A New Magnetic Motorless Railway



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One of the Latest Designs for Electro-Magnetic Railways is Illustrated in Detail Above. No Motors or Gearing are Employed in This System of Propelling Cars by Means of Electro-Magnets, Placed Between the Tracks in the Manner Indicated. Only the Group of Track Magnets Directly Under the Car at Any Moment Are Magnetized. The Repulsion and Attraction Forces Existing at a Given Moment, Between the Track Magnets and the Powerful Electro-Magnet or Magnets Carried Underneath the Car, May be Readily Understood by Studying the Diagrams at the Right of the Illustration, Remembering the Basic Law of Magnetism That—Like Poles Repel, While Unlike Poles Attract.

THE magnetic railway shown in the accompanying illustration, represents one of the latest ideas in transportation. It is based on the principle that action or movement can be and is produced between an electro-magnet and an iron mass or between two electro-magnets, in contra-distinction to the usual electrical railway with which we are all familiar, in which one or more high speed electric motors are used to drive the car wheels thru a system of gears. The present magnetic railway is known as the "Leffler System."

As in every magnetic railway system, the individual magnets in the street, which are placed several feet apart, are only magnetized in short sections as the car passes along. The idea will be evident to anyone who is familiar with the laws of magnetism. Referring for a moment to Fig 2 as well as Fig 3A, it will be seen how successive attraction and repulsion forces are set up between the electro-magnets in the track and the electro-magnet mounted under the car or engine. The moving electro-magnet on the car may be excited by direct current supplied by a battery on the car.

Just how the car is propelled will be understood from the following, referring to Fig. 3A. The first law of magnetism states that like poles repel and unlike poles attract each other; the arrows in the figure show, by the direction in which they point, how these forces operate. Starting at the left hand side, we see that two north poles are opposite each other at the moment selected for our cut, and that they tend to repel each other, while somewhat to the right a north pole is in juxtaposition with a south pole, causing attraction. A little further to the right we see that the south pole above is also in proximity to the central pole, which is south also, causing repulsion (like poles); at the extreme right we have attraction between the unlike poles once more, S above and N below.

As the electric current is past thru the windings of the armature, the downward projecting poles on the armature become polarized in groups, of three to four to a group, as indicated by letters N and S; the center of the groups being the most highly magnetized. These groups of polarity appear alternately every two and a half feet, or half way between the magnets in the track, which in turn also become magnetized, as indicated by the letters N, S, on the track magnets. Opposite poles are attracted, while like poles are repelled, both forces acting to move the armature and thus the car, in the direction indicated by the arrow. By reversing the current in the armature, a quick but easy stop can be

(*Continued on Page 271*)

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The "Aerohydrotor"

By EDWIN F. LINDER

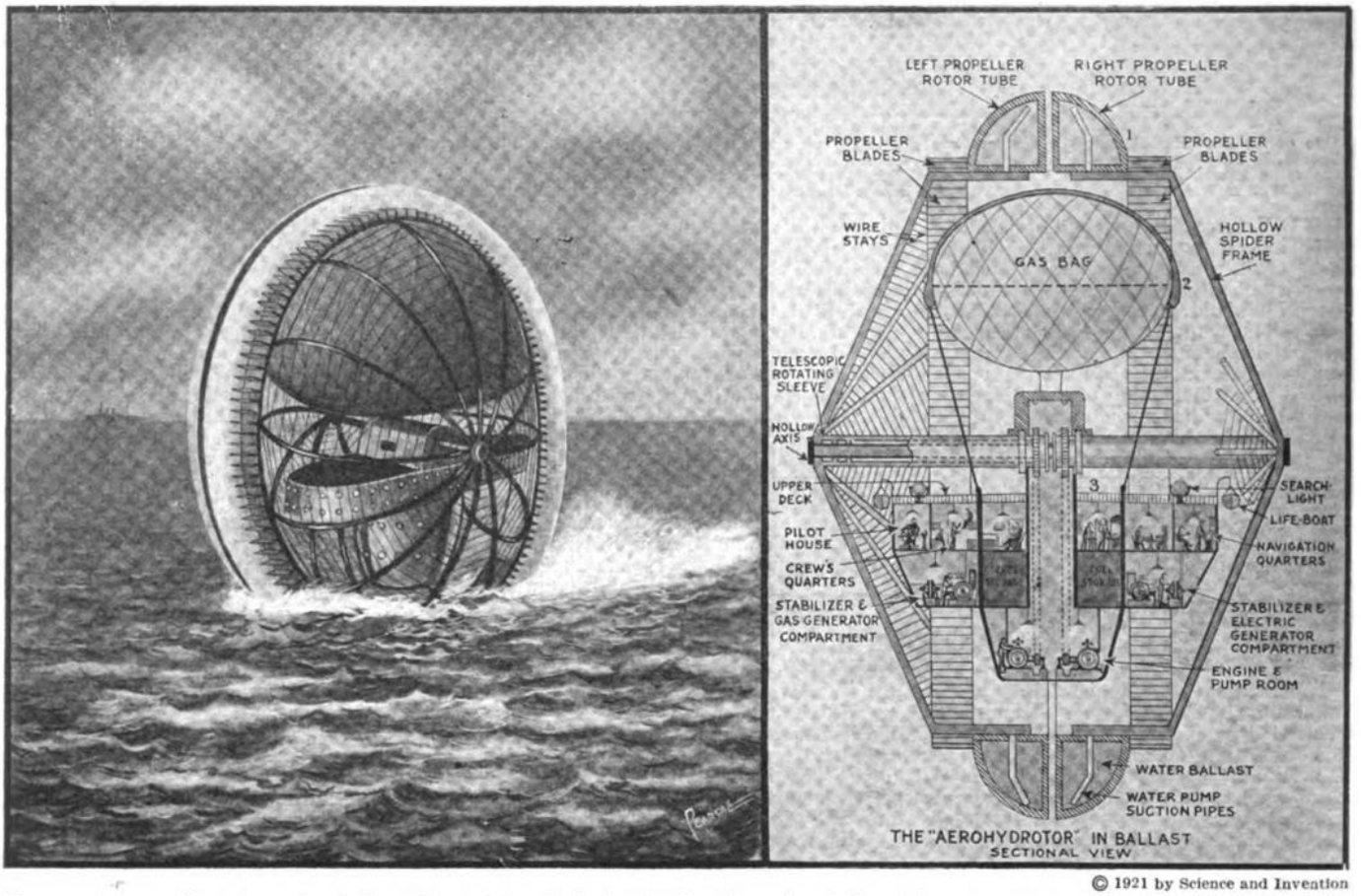
TALK about speed! Is 200 miles per hour a fast clip? Well, that figures 3 1-3 miles per minute or 290 feet per second. Now, that may seem a great distance to cover in a short space of time, yet if exprest in terms of rotation it will appear to the trained mechanical mind to be rather ordinary.

The Aerohydrotor is designed to travel at the rate of 200 miles an hour under normal conditions. The diameter of the propeller-rotors being about of smaller proportions produced for purposes of super-rapid ocean transit.

In describing the construction of this "Speed King of the Seas" it may be of interest to state that the craft consists chiefly of three units. "No. 1"—the propeller-rotor-tube, which takes the place of the usual hull. "No. 2"—the gas-bag. "No. 3"—the quarters, pilot and machine compartments. When in operation Units "No. 2" and "No. 3" remain in a fixt position, while "No. 1" revolves.

It can be easily understood that the steering is accomplished by speeding up or slowing down one or the other side of the spider-frame driven on the axis, upon which are mounted telescopic sleeves carrying the driving gears. The spider frame arms are hollow; thru these ballast water is expelled after the Aerohydrotor starts on its voyage.

On approaching its destination ballast water is again pumped into the tube. In this manner a greater degree of stability is maintained.



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The "Aero-hyd-rotor" is the Latest Idea in Ocean-Going Craft and is Designed to Travel at a Speed of 200 Miles Per Hour or More, so That It Could Cross the Atlantic in 12 to 16 Hours. The Gigantic Wheel with Its Propelling Blades Measures 93 Feet in Diameter. The Craft is Kept Upright by Gyroscopic Action and Also by the Huge Gas Bag at the Top, Which is Filled With Helium—the New Non-Inflammable Balloon Inflating Medium. Gas or Gasoline Engines Drive the Craft

93 feet. Let us assume, for the purpose of illustration, that friction and air resistances are not to be considered and that the diameter of the propeller-rotors is 93 feet. With each revolution thereof a distance of 290 feet can be attained.

As the Aerohydrotor is so constructed that it makes at an average one revolution per second—only sixty turns each minute—it surely can not be said to be breaking the record for rotation. This is really a very old fashioned rate, compared to high speed electro-motors running 1,000 revolutions per minute, or even higher. So with the one turn the Aerohydrotor traverses over 290 feet each second, or in sixty turns — 17,400 feet (3.3 miles) per minute. Then in making 3,600 revolutions per hour — a very low rate indeed—it leaves in its wake just 1,044,000 feet or 200 miles.

It is quite possible that by tuning up the Aerohydrotor a much higher rate of speed will eventually be obtained, or the same distance covered with a craft

So far as possible all parts are made of dur-aluminum, and wire stayed. This lends both strength and the necessary feature of light weight to the structure.

The motive power is furnished by the installation of gas engines, located in the lower compartment, which is shown suspended from the passenger quarters. Stabilizers assist in keeping the craft in an upright position while in motion, the gas bag, at the same time, performing this service besides lifting the craft so that it keeps up well on the surface of the water. Light and heat are derived from an electric generator unit. Water pumps, a gas generator to replenish the supply are included in the equipment.

It is difficult to explain, without going into great detail, the peculiar construction of the rotor-tube and propeller-blade ring. These are arranged so that each can be driven independently of the other, the tube being split, half rotating with each set of propeller rings.

At this time it is not intended that the Aerohydrotor should be used for other than passenger and mail service in a limited way, where super-speed is of the greatest importance. While its advantages possibly do not contribute to the improvement in a large degree in the commercial field, except as a medium of rapid exchange of mail, the use to which such a speedy craft can be put as a weapon of destruction on the high seas in naval warfare is worthy of consideration. A fleet of these, acting as scouts to locate enemy squadrons, could patrol so great an area distant from defensive lines, that long before the approaching squadrons need be met in combat, all necessary arrangements for the attack could be made.

Let us hope, however, that the Aerohydrotor will only be used for the peaceful purposes of super-transit on the great highways of the seas.

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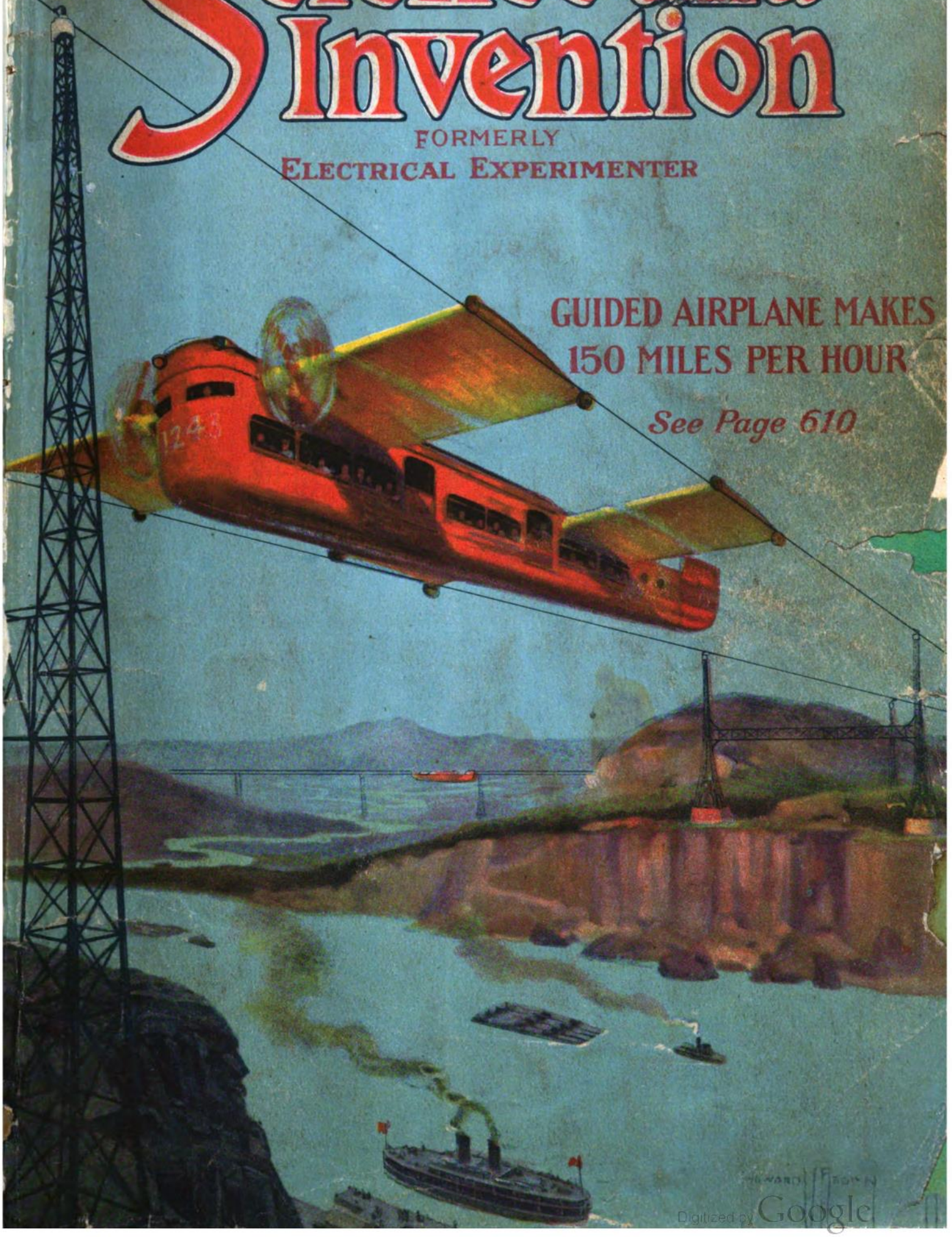

GUIDED AIRPLANE MAKES 150 MILES PER HOUR

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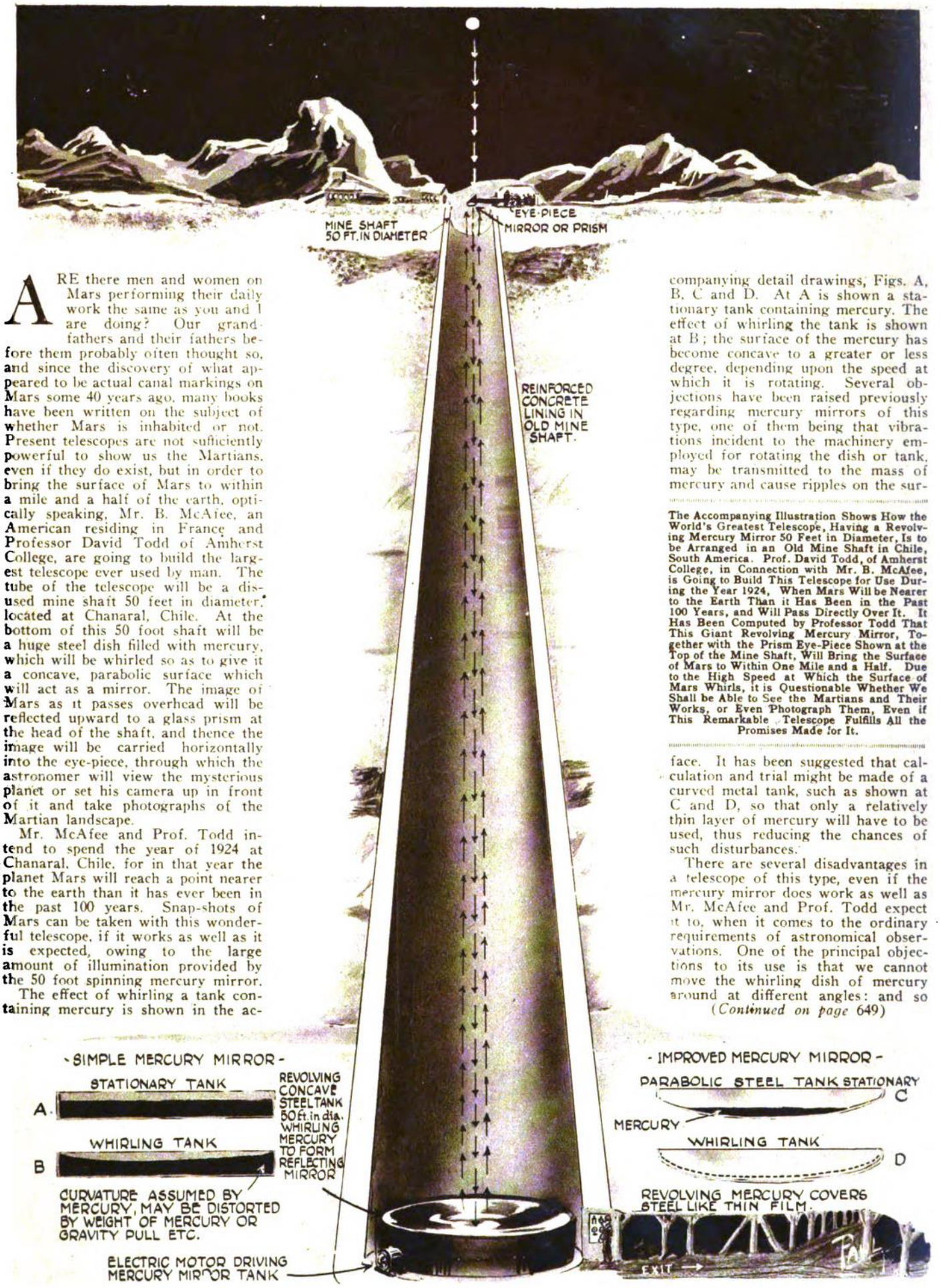
Mercury Mirror to Bring Mars Close



The Accompanying Illustration Shows How the World's Greatest Telescope, Having a Revolving Mercury Mirror 50 Feet in Diameter, Is to be Arranged in an Old Mine Shaft in Chile, South America. Prof. David Todd, of Amherst College, in Connection with Mr. B. McAfee, is Going to Build This Telescope for Use During the Year 1924, When Mars Will be Nearer to the Earth Than it Has Been in the Past 100 Years, and Will Pass Directly Over It. It Has Been Computed by Professor Todd That This Giant Revolving Mercury Mirror, Together with the Prism Eye-Piece Shown at the Top of the Mine Shaft, Will Bring the Surface of Mars to Within One Mile and a Half. Due to the High Speed at Which the Surface of Mars Whirls, it is Questionable Whether We Shall be Able to See the Martians and Their Works, or Even Photograph Them, Even if This Remarkable Telescope Fulfills All the Promises Made for It.

ARE there men and women on Mars performing their daily work the same as you and I are doing? Our grandfathers and their fathers before them probably often thought so, and since the discovery of what appeared to be actual canal markings on Mars some 40 years ago, many books have been written on the subject of whether Mars is inhabited or not. Present telescopes are not sufficiently powerful to show us the Martians, even if they do exist, but in order to bring the surface of Mars to within a mile and a half of the earth, optically speaking, Mr. B. McAfee, an American residing in France and Professor David Todd of Amherst College, are going to build the largest telescope ever used by man. The tube of the telescope will be a disused mine shaft 50 feet in diameter, located at Chanaral, Chile. At the bottom of this 50 foot shaft will be a huge steel dish filled with mercury, which will be whirled so as to give it a concave, parabolic surface which will act as a mirror. The image of Mars as it passes overhead will be reflected upward to a glass prism at the head of the shaft, and thence the image will be carried horizontally into the eye-piece, through which the astronomer will view the mysterious planet or set his camera up in front of it and take photographs of the Martian landscape.

Mr. McAfee and Prof. Todd intend to spend the year of 1924 at Chanaral, Chile, for in that year the planet Mars will reach a point nearer to the earth than it has ever been in the past 100 years. Snap-shots of Mars can be taken with this wonderful telescope, if it works as well as it is expected, owing to the large amount of illumination provided by the 50 foot spinning mercury mirror.

The effect of whirling a tank containing mercury is shown in the accompanying detail drawings, Figs. A, B, C and D. At A is shown a stationary tank containing mercury. The effect of whirling the tank is shown at B; the surface of the mercury has become concave to a greater or less degree, depending upon the speed at which it is rotating. Several objections have been raised previously regarding mercury mirrors of this type, one of them being that vibrations incident to the machinery employed for rotating the dish or tank, may be transmitted to the mass of mercury and cause ripples on the surface. It has been suggested that calculation and trial might be made of a curved metal tank, such as shown at C and D, so that only a relatively thin layer of mercury will have to be used, thus reducing the chances of such disturbances.

There are several disadvantages in a telescope of this type, even if the mercury mirror does work as well as Mr. McAfee and Prof. Todd expect it to, when it comes to the ordinary requirements of astronomical observations. One of the principal objections to its use is that we cannot move the whirling dish of mercury around at different angles: and so

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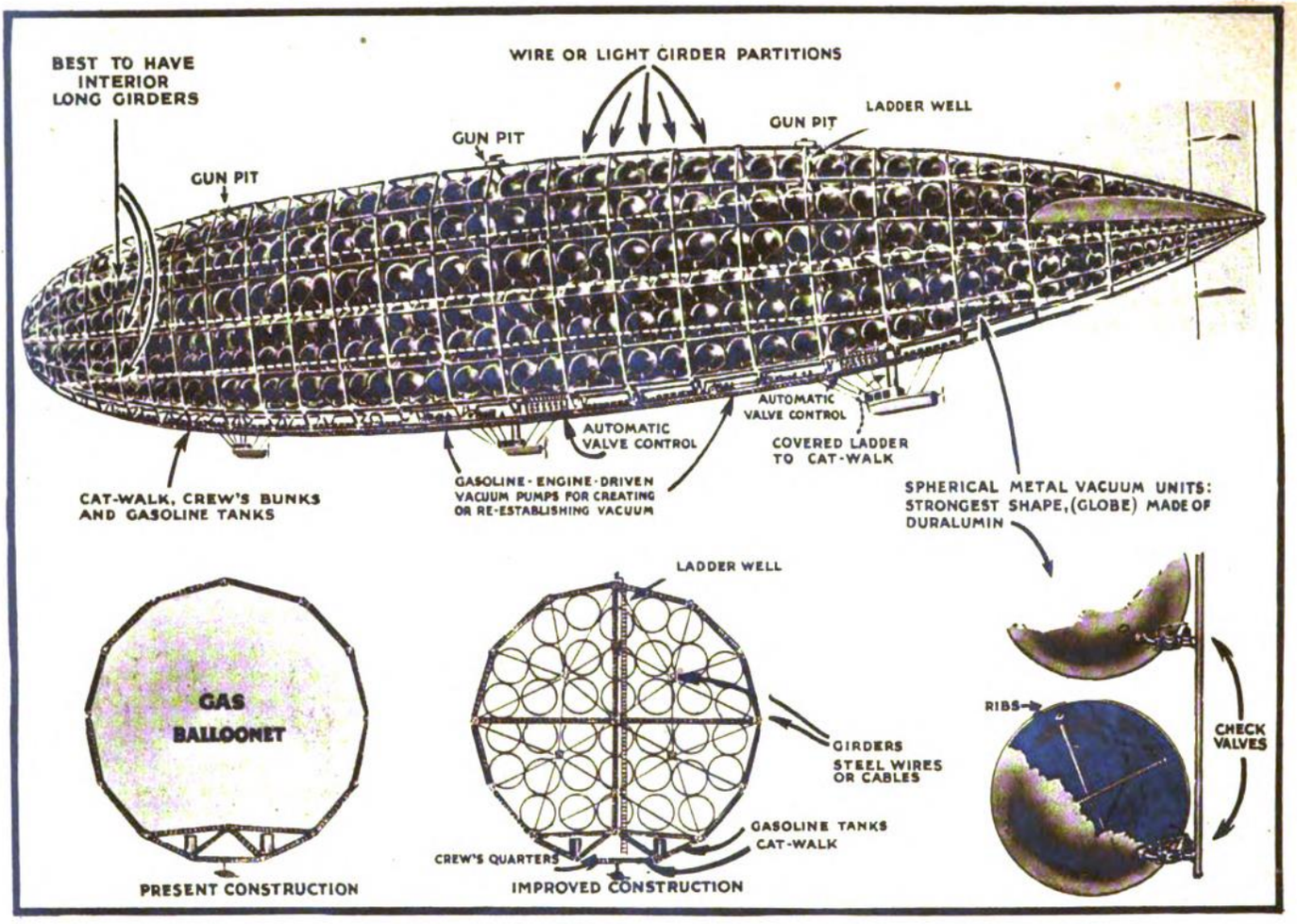

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Since the Deplorable Disaster which Befell the ZR-2 Dirigible in England, which Accident was Described at Length in Our October Number, Danger from Future Explosions or Fire Due to Filling Airships with a Combustible Gas, has Caused Inventors and Engineers to Strive to Develop a Safer Method of Building a Lighter-Than-Air Flying Craft. The Illustration Above Shows Some of the Outstanding Features in Designing a Vacuum Airship, while the Merits and Demerits of Such a Dirigible as well as Its Lifting Power Compared to the ZR-2, are Discust in the Article Presented Herewith.

Is the Vacuum Airship Practical?

By H. WINFIELD SECOR

RECENT dispatches from Paris and other European points have excited the minds of aviation enthusiasts by the news of a wonderful new lighter-than-air flying machine which is said to be under construction at Naples, Italy. Unlike the ill-fated ZR-2 and other dirigibles, including the Zeppelins built by the Germans, this new Italian airship is said to employ no gas at all—but instead a vacuum. In other words, all we are supposed to do to make this machine a success is to have suitably strong compartments and to exhaust the air from these when the airship will supposedly rise. Of course this phenomenon is based on the scientific fact that air does have weight; and to be exact the weight of ordinary dry air is given by Professor Humphreys in his *Physics of the Air* as 565 grains, or 1.29152 ounces per cubic foot.

Thus with a flying machine of the dirigible type said to have been invented by two Italians, Vaugeau and Gargiulo, and built large enough to have a capacity of 2,000,000 cu. ft., similar to the large British dirigibles, by simple computation, we find that if we exhaust this airship of its 2,000,000 cu. ft. of air we would create a total lifting effort of 161,250 pounds, equivalent to 80.6 tons. It is well to remember at this point that the lifting power of the ZR-2 was about 50 tons. So far the vacuum airship sounds like a good proposition, but we are confronted with the cold fact that from this gross lifting power of 80½ tons, we will have to deduct the weight of the airship itself, and it looks very much to us as if, when this is done, our net useful lift will be somewhere around the zero point.

Stop to think for a moment just what kind of construction will have to be employed in building compartments capable of being exhausted to almost a perfect vacuum. You will remember that our physics books taught us that unless a chamber was very strong, it would collapse, due to atmospheric pressure, when a perfect vacuum was produced. Of course we cannot create a state of perfect vacuity even in the laboratory to-day, with our finest condensation and molecular pumps, and it will probably not be possible to create a very remarkable vacuum in the airship compartments. It would thus seem that after we have built an airship with compartments strong enough to withstand the outside atmospheric pressure when the air is pumped out of them (there will undoubtedly be only a fair degree of vacuum produced in the compartments), we can hardly expect the airship to rise, even if it only has to carry up its own frame.

The accompanying illustration shows several ideas which would apply in designing a practicable vacuum airship. First it would seem almost impossible to provide very large vacuum chambers, and it would seem advisable that these be formed rather small and of spherical shape, for we know that a sphere presents the greatest strength of any geometrical shape. These spheres may be made of a light metal such as duralumin with ribs or braces inside of them for additional strength, and they might be arranged in groups, as shown in the illustration. All of the spherical compartments in one group would be joined together by suitable pipes fitted with check valves, and at the bottom of each compartment a pipe would lead to a central control board, where gasoline-engine driven vacuum pumps would connect with the pipe lines to exhaust the air from the chambers. Instead of carrying sand or water ballast for raising and lowering the airship, more or less air could be taken from the vacuum chambers fore and aft, so that the airship would lower or raise its nose correspondingly. Automatic vacuum valves could be arranged on the control boards so that, during a voyage when any of the vacuum compartments might need re-exhausting, this will be done automatically.

(*Continued on page* 670)

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Earthquakes Made to Order

EARTHQUAKES are not of such frequent occurrence, for which we are duly thankful, that motion picture photographers can dash about and snap the majestic scene of rock and dirt being blown skyward, while a white-hot adjacent volcanic crater vomits forth boiling lava. Hence and wherefore, we have with us something brand new now in motion picturedom—the earthquake made to order.

The accompanying illustrations show clearly how the artificial volcanic and earthquake effect was staged in photographing a recent motion picture scene produced by an American photoplay company. The limit of vision for the battery of motion picture cameras is indicated by the lines A-A in the picture. A first-class earthquake with accompanying volcanic eruption was produced

This Volcanic Eruption and the Accompanying Earthquake Represents the Highest Pinnacle of the Motion Picture Art. A Small Hill Was Used to Build the Volcano on, Rocks and Dirt Being Blown Skyward With the Usual Smoke and Dust, by Means of Steam Shot Thru Jets Placed in the Crater of the Made to Order Volcano, as the Illustration Clearly Shows. The Molten Lava Which Flowed Down the Crevices of the Volcano Was Composed of a Solution Resembling Whitewash, Forced Out of the Pipes by Steam Pressure at a Boiling Temperature. The Earthquake Effect Was Realisticall Duplicated by Pulling Triangular Shaped Earth Sections to One Side, by Means of Motor Tractors, While the Flimsily Built Houses Collapsed and Started to Burn.

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in this scene, and in a relatively simple manner at that. Several platforms were arranged on wheels so as to be movable along tracks for a short distance as the picture shows at the left. Each of these platforms had a section of earth represented on it by a framework which was covered with paper pulp and fabric suitably painted; when all of these sections were pulled to the left by the automobile tractors at the director's signal, the effect of ever-widening fissures or chasms in the earth was produced in a startlingly realistic manner. Pieces of canvas were placed across any open junctures between the platform sections and loose soil placed over them. Next the buildings, which were erected in a specially flimsy manner, fell down when jarred, and when certain support sticks were pulled from under by hidden wires, all of the terrors of a devastating earthquake and volcanic eruption were evolved with remarkable fidelity.

A few hundred actors and supers dashing about wildly over the crevices, coupled with falling buildings and the white hot lava trickling down the sides of the mountain in the background, all helped in producing this wonderful motion picture. Even the dense clouds of smoke which usually accompany volcanic eruptions were produced by the artificial volcano.

One of the accompanying illustrations shows a sectional view of the movie-made volcano which poured forth rocks, dirt, smoke and lava, all in bounteous profusion, at the critical moment when the director-in-chief gave the order, his assistant directors in various parts of the scene being connected with his station by telephone. Steam boilers supplied both smoke and steam, which shot upward from the crater at the top of the volcano, suitable valves and dampers being provided for the control of the effects.

If you have ever seen a steam or compressed air pipe, or even a high pressure water pipe discharge into loose dirt and stones, you will have a vivid idea of how this volcanic eruption was made to order. The top of the crater was filled with loose rocks and dirt and when the steam was turned on, slowly at first, the dirt and smaller stones were shot upward, while the smoke added its accompanying effect. After a few moments the molten lava began to pour down the mountain slopes, just as you remember having seen it do in actual

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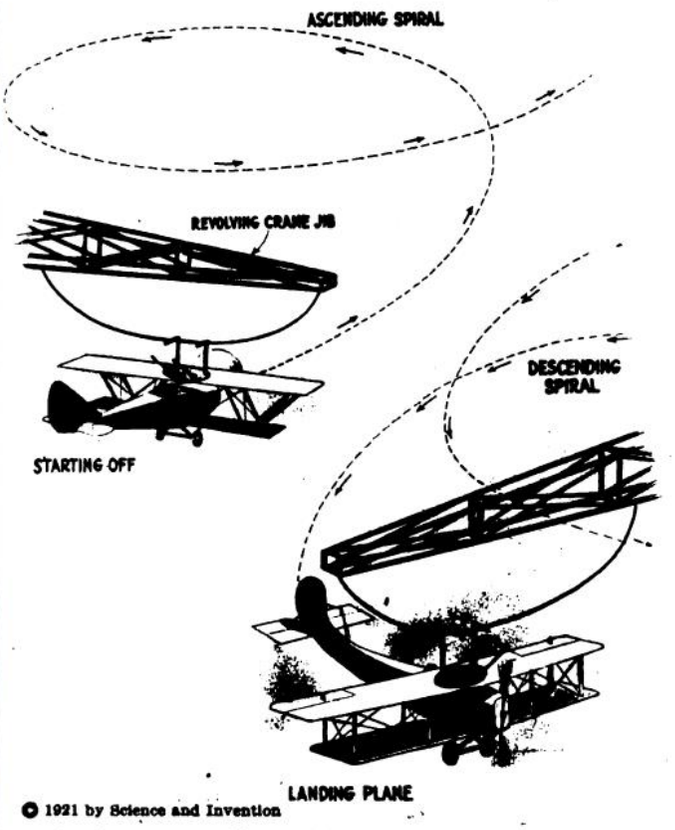
Magnets and Cranes to Handle 'Planes



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The Airplane Landing and Starting Device Shown Above was Recently Patented by an American Inventor. The Principal Use of This Invention Will Undoubtedly be in Crowded Districts. In the Base of the Tower There Is a Storage Space for Airplanes and Elevators Raise Them to the Starting and Landing Platform. The Crane Revolves and Can be Tipt Gradually to Any Angle, the Planes Ascending or Descending in a Spiral in Starting or Landing, as Depicted at the Right.

ONE of the accompanying illustrations shows a scheme suggested by an American genius, one Raymond Noble Coffman, whereby he proposes to accelerate as well as decelerate airplanes, as they move over a revolvable turn-table erected on the top of a high building; all by means of powerful electro-magnets. Several years ago an elaborate article appeared in the pages of this journal describing a scheme for stopping large aircraft quickly, when they had landed, by means of powerful electro-magnets mounted flush with the floor of the aerial platform, similar to the arrangement here illustrated. Mr. Coffman's scheme, however, is somewhat on the order of the electro-magnetic gun, in that he proposes to rapidly accelerate or increase the speed of the airplane by exciting the series of electro-magnets one after another in rapid succession. As the electro-magnet just ahead of the airplane is switched on each time, the one over which the plane had just moved is cut out of circuit, and as experiments with electro-magnets have shown, a very rapid acceleration of an object in this manner is readily obtainable. Of course, the airplane engine and propeller would help to shorten the accelerating period considerably. In order that the magnets can act on the plane properly to pull it forward, one after another, there is an iron plate fastened underneath the plane on the landing wheel chassis.

Revolving Crane for Starting and Landing Airplanes

The second illustration herewith presented shows a very ingenious and interesting device on which a patent has been issued by Johnny S. Black, of New York City. As the illustration depicts, Mr. Black's device, for starting as well as landing airplanes, comprises a central tower-like structure, around the upper part of which a balanced jib or crane can revolve. Airplanes which may have landed on the ground, are run in thru the doorways in the base platform, and on to one of the large electrically operated elevators, shown in the picture. By means of the elevator the airplane is raised to the starting and landing deck. A loop of flexible steel cable hangs downward from the outer end of the jib arm in the manner indicated.

Airplanes designed to be started or landed with this machine are fitted with special collapsible hook members, which are clearly shown in the photo. The pilot pulls on two handles, which action raises the hook members, and he revolves the plate on which they are mounted, according to whether it is going to start off or land, as shown in the two detail illustrations at the right.

When the "L" shaped hook members are over the cable in the position shown

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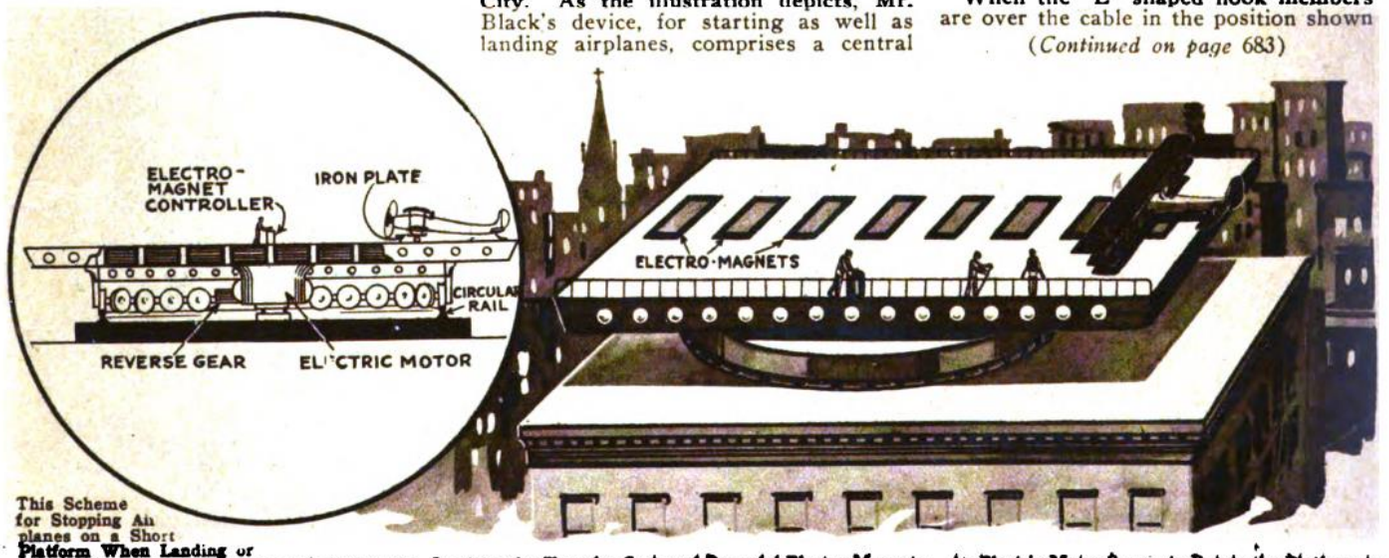

This Scheme for Stopping Airplanes on a Short Platform When Landing or Accelerating Them Rapidly In a Limited Space, Involves the Use of a Series of Powerful Electro-Magnets. An Electric Motor Serves to Rotate the Platform to Suit Different Wind and Weather Conditions. An Iron Plate is Mounted Under the Plane for the Magnets to Act Upon, the Magnet Poles and Windings Being Made Flush with the Platform Floor. The Magnets are Excited Progressively to Accelerate a Plane.

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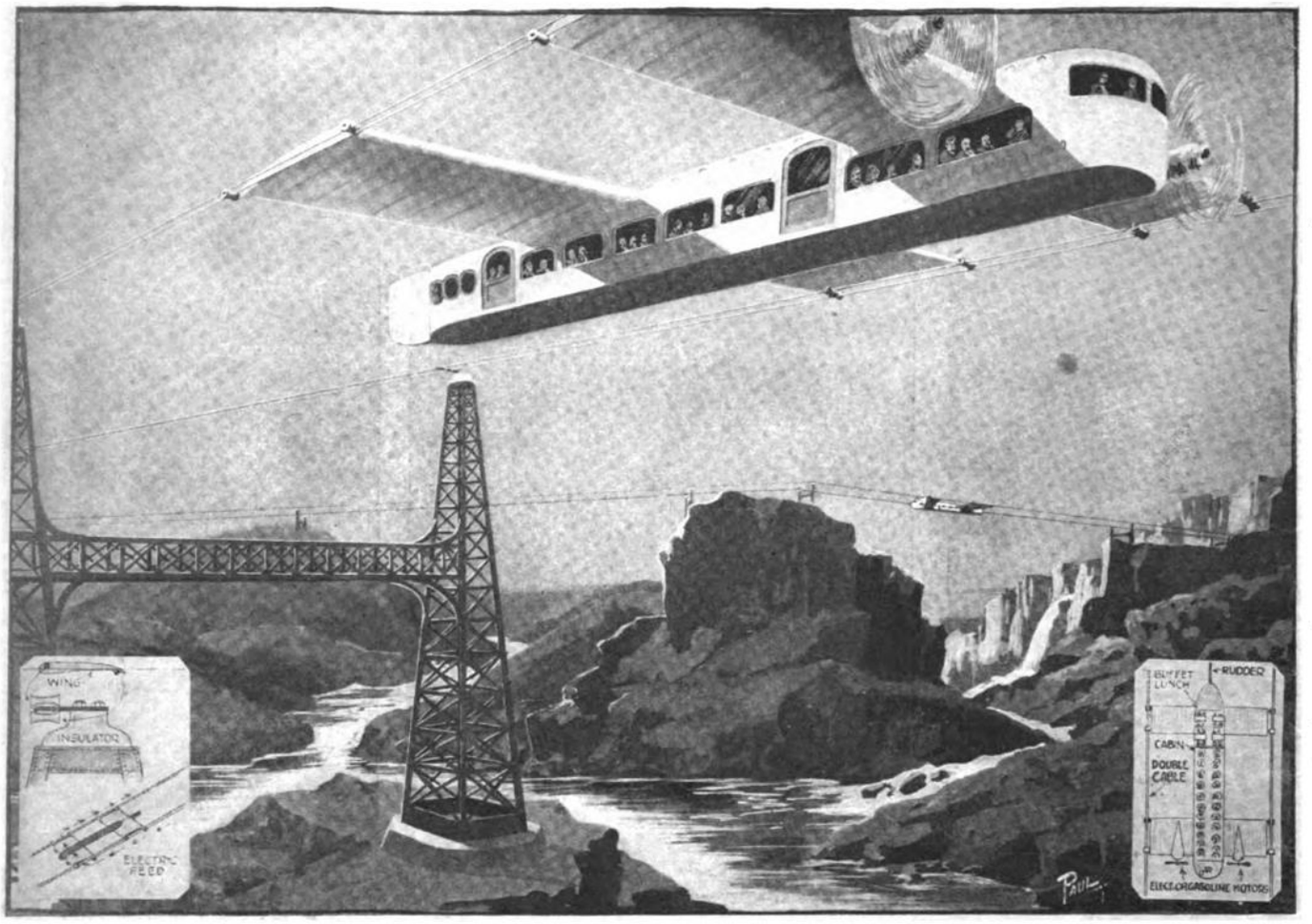
Guided Airplane Makes 150 Miles an Hour



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This Aerial Railway Having Cars Designed Like Airplanes, but With the Advantage That They Are Guided Along Cables Instead of Having to Find Their Way Thru Fog and Storm, Is Actually to be Built in England, Recent European Reports Indicate. The Cars Can Attain a Speed of 150 Miles an Hour Easily, and May be Propelled by Gasoline Engines With the Usual Air Propellers, or else the Propellers May be Driven by Electric Motors, Deriving the Necessary Current from the Wire Cables on Which the Craft Glides. When the Cars Are in Motion There Is Practically no Strain Exerted on the Cables and Towers, as the Wings Will Exert a Powerful Lifting Effect Sufficient to "Float" the Car, While in Rounding Curves the Car Can be Steered by Means of Its Rudder and Tail so as to Minimize Any Strains on the Cables. The Cables Pass Over and Under Alternate Grooved Wheels on the Extremities of the Wings, so that the Cars Cannot Fly Off the Cables, if the Lifting Effect of the Wings Should Become Momentarily Excessive.

IT has been proposed to build an aerial railway, such as shown in our front cover illustration, and also in the accompanying view, in England and other countries, the cars of these railways resembling giant airplanes, and the speed at which they travel approximating 150 miles an hour. This speed should be readily attainable by an aerial car such as that shown in the picture, for the reason that, when the car attains such a speed as 80 to 100 miles an hour, the wings will tend to raise the car in the same way as an ordinary airplane performs. Thus, the car will exert but very little if any pressure due to its weight upon the steel cables along which it travels. In other words, these cables will simply act as guides, in much the same way as General Squier has proposed the use of wires in directing radio waves and currents, which system he terms, *Wired Wireless*.

In the system we are describing, we have a guided aircraft, and judging by the number of accidents which have occurred, especially in stormy weather, when planes have become lost, due to fog and clouds, and have attempted landings in woody sections or other impossible places with disastrous results in many cases, this scheme of providing tracks so to speak, for the airplanes, should prove very welcome. All of the smoothness and speed-abilities of the airplane will be retained and at the same time you will know, when you leave Chicago for example, that you are going to reach the next stop without landing in the top of a tree or some worse place. Besides, airplane engines are not absolutely infallible, and they have a habit of stopping sometimes at very inopportune moments—and when they do stop and they won't start again with the aid of the self-starter or otherwise—there is only one thing for your pilot to do, and that is make a vol-plane landing, and to be mighty quick about it. Of course, the higher the free airplane happens to be, the greater the distance over which the plane can glide before landing, but if you happen to be flying over barren country which frequently occurs, especially with long distance mail and passenger 'planes, you do not always have a good choice of ground on which to land.

It is stated in reports from Europe that they actually expect to build an aerial railway like that shown, and presumably from what information has been given out, the cars will be propelled by means of gasoline engines and the usual propellers. There is another way in which the cars can be propelled and that is by electric motors, the necessary current being supplied from the cables over which the car travels. These cables do not have to be as heavy or as strongly supported as might at first be imagined, for the reason already mentioned, for when the airplane reaches a certain speed, usually about 40 miles an hour, the wings will start to exert a lifting effort and the cars, therefore, will be flying in the air in the same way as if there were no cables at all. But instead of flying free as our ordinary aircraft do at present, these cars will be guided by the cables and will reach their destination with clocklike regularity. These aerial railway cars can be operated in both directions of travel, the cars passing one another side by side, or else one above the other, depending upon the design of the supporting cables and towers. Note that the grooved wheels pass over and under the cables alternately, so as to retain the craft on the wires.

One of the outstanding features of such an aerial railway, which would be a big boon to passenger and freight transportation in any country where large areas of territory are to be served, such as in the central and

(*Continued on page* 643)

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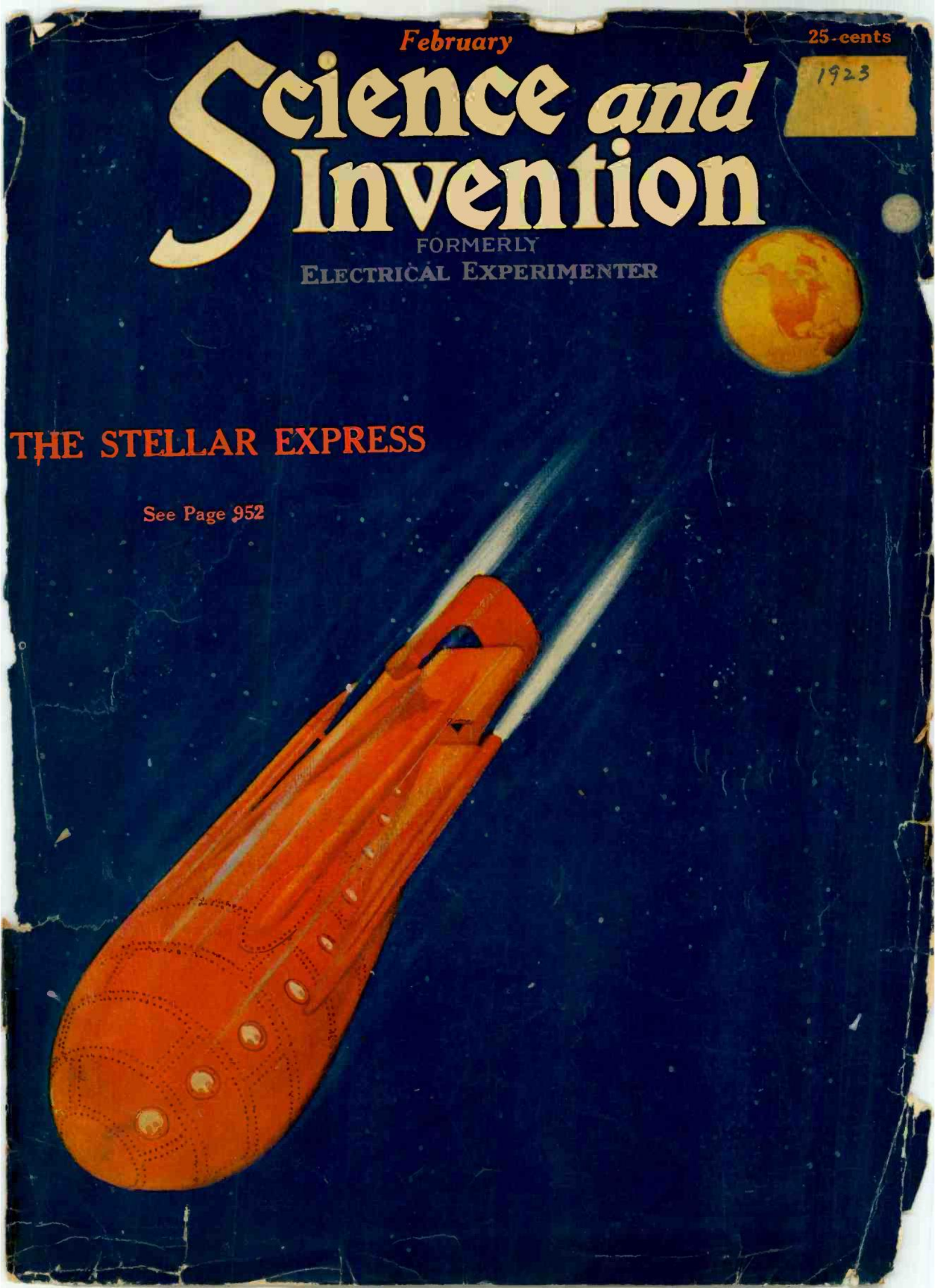
Science and Invention

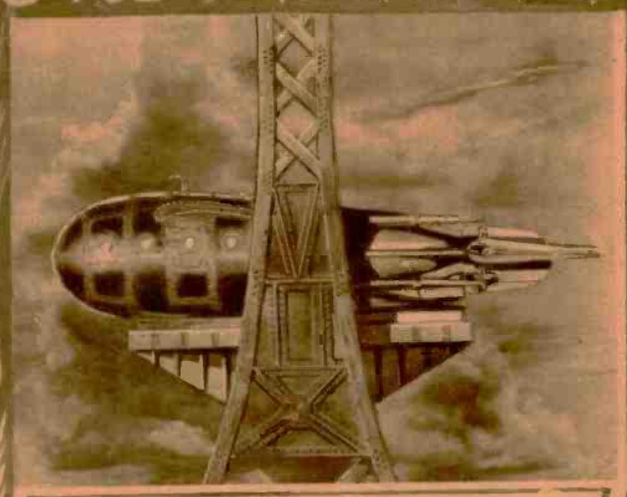
FORMERLY
ELECTRICAL EXPERIMENTER

THE STELLAR EXPRESS

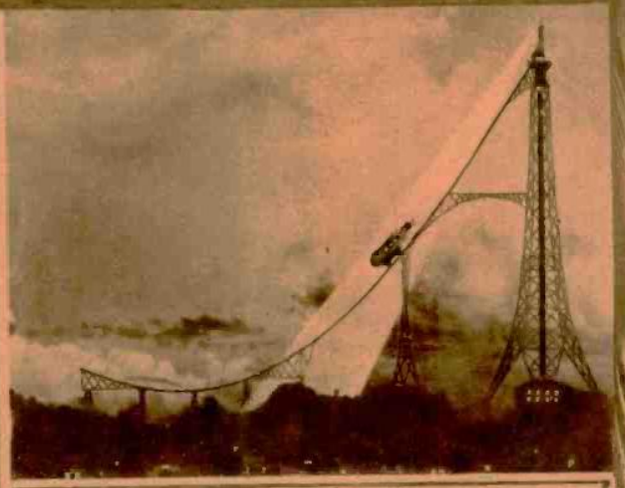
See Page 952



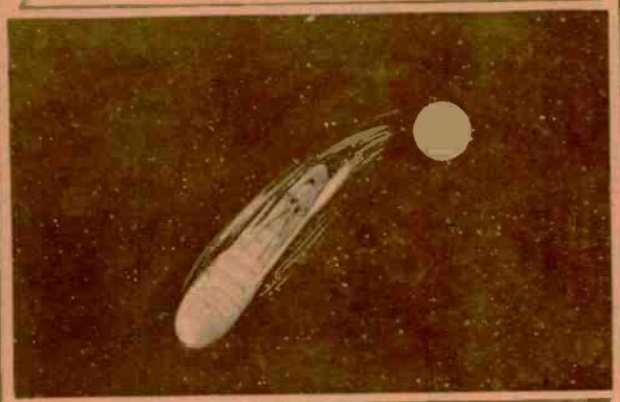
The STELLAR EXPRESS



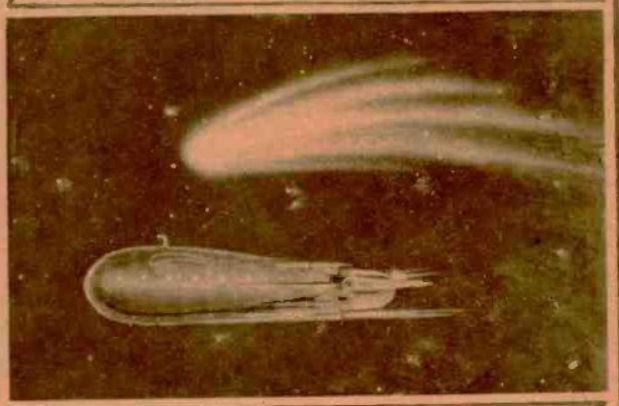
Professor Cooley's projectorcar for navigating interstellar space on its elevated launching platform.



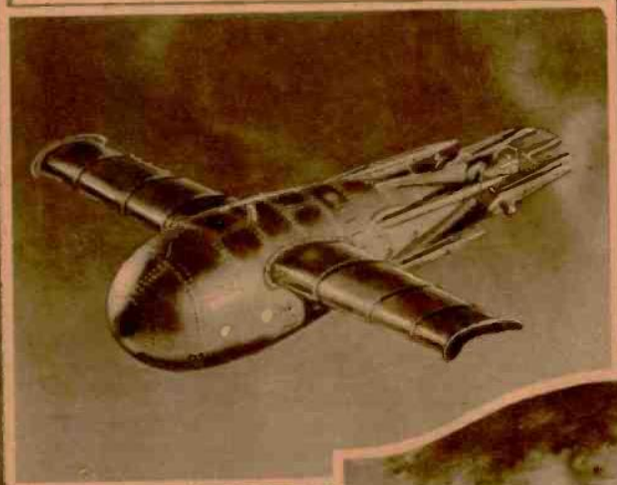
The projectorcar being launched from high tower, for its first trip to Mars and other planets.



Professor Cooley's projectorcar leaving the earth behind on its journey to other planets.



The stellar express has a race with a comet, and out-speeds the fiery demon of space.



Professor Cooley's stellar express spreading its telescopic wings, preparatory to alighting on an unknown planet. The machine is designed so that when once in flight, the wings may be telescoped, so as to minimize air friction and realize the maximum speed.

The picture to the right shows the giant observatory on the strange world, from which Professor Cooley, looking back at the earth, discovered that he had actually beaten light itself by fifty years.

Picture above shows Professor Cooley alighting on strange world from his space flier, after the most extraordinary voyage in all history. He gets a cordial reception from the strange dwellers in the unknown world.

Navigating Interstellar Space

By CHARLES FREDERICK CARTER

THE announcement of Prof. T. J. J. See, Government Astronomer at Mare Island, that he had discovered the cause of universal gravitation was made just in time to lend an air of plausibility to a tale of adventure that fairly outdistances any previous flight of imagination. The story is produced as a moving picture, entitled "The Sky Splitter."

Originally conceived as an entertaining phantasmagoria, "The Sky Splitter," in the light of Professor See's discovery, becomes a suggestion of fascinating scientific possibilities—not probabilities, however. Since we now know what gravitation is, if we follow, understand and believe Professor See's conclusions, may we not apply that knowledge of the force which holds the planets in their orbits to navigation of interstellar space? Can we not now go and find out for ourselves whether Mars and Jupiter and Venus and other planets that have been discussed are really inhabited or not? All that is lacking now is suitable motive power. The source of that has been suggested by the discovery of radium by the Curies.

The scenario writer has certainly beaten science by a few laps (perhaps). Briefly, the story of "The Sky Splitter" is about Prof. Adam Cooley, B.A., Ph.D., D.Sc., like Professor See, an astronomer, who has devoted the better part of his life in attempting to develop a motor, actuated by atomic force which is now supposed to be akin to the emanations from radium. In time, the Professor masters the secret. He decides to try it out on an old automobile, so that if anything happens he will not lose much. That was a lucky thought, for atomic force when harnessed proves to be so much more powerful than anything hitherto known, that the Professor runs into a stone fence and comes pretty near being launched into infinity without any further aid from atomic force.

Naturally, he is laughed at after this experience. Many great discoverers have had the same experience. If Professor Cooley had been overlooked, that fact would have demonstrated that he was not the real thing in discoverers.

Unluckily for him, one of the scoffers is Paul, who adores Marcel, Professor Cooley's daughter, a maiden as beautiful as the houris and as wise as Zobeide. She gives Paul a piece of her mind for his rudeness to her father and in polite phrase tells him to go. The only way Paul can get back into Marcel's good graces is to play Angel to the Professor's discovery. In other words, Paul advances the money to build a Projectocar in which the Professor proposes to go on a voyage of discovery among the stars, the propelling power to be his newly patented atomic force motor.

March Features in Science and Invention

The Star—A Tale of the Comet. By H. G. Wells, World's Famous Scientific Fiction Writer, Who Holds Your Interest to the Last. Don't Miss It.

Chicago-New York-Berlin-Via Zeppelin. By Dr. Becher. Illustrated with latest photos of German airships.

Radio Wave Traps and Filter Circuits for Maximum Selectivity. By A. P. Peck.

Practical Chemical Experiments—A brand new series. By Raymond B. Wailes. Illustrated.

The Obedient Candles—Magic For the Amateur. By Joseph H. Kraus.

How and When Does Electricity Kill—Popular discussion, with illustrations for the layman.

How to Use Your Camera—Part 3. By Dr. Ernest Bade.

Telegraphing Pictures Across the United States. By D. W. Isakson.

Measuring One-Millionth of an Inch.

How Old Is the World? By Harry Van Demar.

Why Balsa Wood Weighs Less Than Other Woods. By Dr. Becher.

On the same theory that he used an old auto for his first experiment with the new motive power, Professor Cooley refuses to risk wasting any more of the family than necessary on his voyage into infinity. Marcel is ordered to stay at home, while the Profesor sails off alone.

The Projectocar is launched down a steel toboggan slide from the top of a steel structure like the Eiffel Tower to give it sufficient momentum to carry it off into space, for it has no landing wheels. Professor Cooley enjoys the first few seconds of his voyage as he gazes back at the swiftly receding earth. But when he finds himself beyond the earth's atmosphere he begins to wonder whether, after all, his voyage was wise. He reaches for his control levers, but finds them useless because there is no resisting atmosphere to be worked upon. By this time he is quite sure he made a mistake in leaving the best world he ever lived on. He faints away.

On recovering he plucks up courage again; he looks out of his periscope to find that his Projectocar is racing with a comet and leaving it behind as if it was tied to a post. Next he flashes past a planet which he recognizes as Saturn, on account of its fondness for rings. Soon he finds himself approaching a planet to which he has never been introduced, astronomer that he is. Thinking the joke has gone about far enough he once more plucks at his lever in a frenzy of energy, determined to make a landing. To his joy, he finds the controls working perfectly, for he is in an atmosphere once more. He circles gracefully about seeking a landing but not being too particular about it. All he wants now is to get out of that Projectocar.

Upon coming to rest, he alights and is greeted by beings, who, he sees at once, are of superior intelligence. At least they have sense enough to stay at home and not go gallivanting around among strange stars. There is some difficulty in making himself understood, but upon being conducted to an observatory he finds astronomical maps on which he locates the earth. He indicates that he came from there. The strangers are too polite to apply the short and ugly word. Instead, they focus their telescope on the earth and invite Professor Cooley to look.

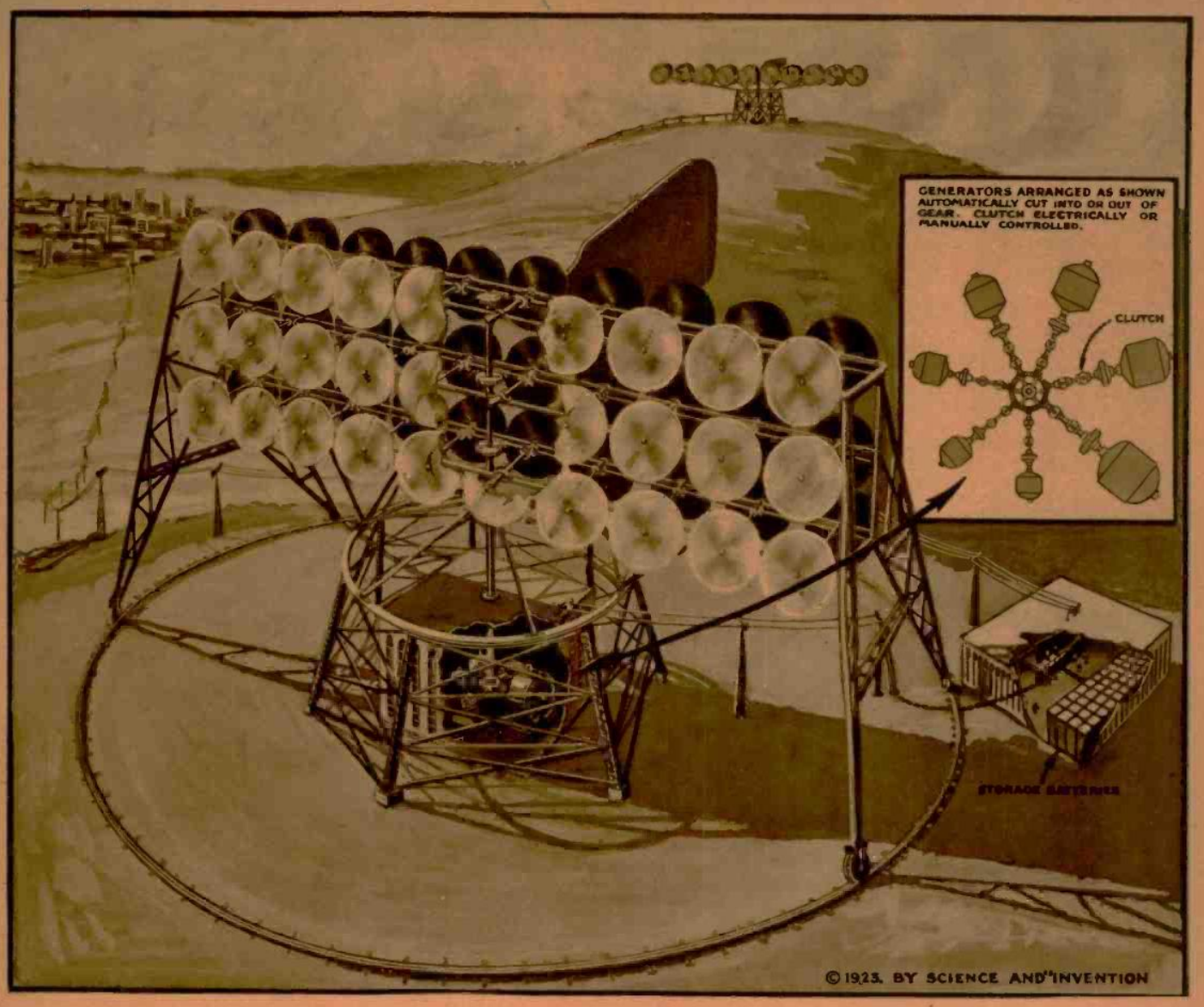
The telescope is so much more powerful than any known on this earth that the Professor is actually able to pick out his old home town. But it doesn't look familiar. Finally, though, it dawns upon him that he has traveled so much faster than light, the swiftest thing hitherto known, that he is now actually seeing images that left the earth on beams of light when he was a boy fifty years before. Calling for pencil and scratch pad, Professor Cooley does some rapid calculating and finds that he is now 293,994,584,070,194½ miles from home. If he is to get back in time for the wedding of Paul and Marcel, he will have to hurry even with so swift a vehicle as the Projectocar.

Before dismissing this with a laugh, try to remember what you thought of Jules Verne's "Twenty Thousand Leagues Under the Sea." That was too fantastic to discuss when it was first published. Navigating the depths of the sea was wildly impossible. But since then the submarine has become commonplace. If the force that holds the planets in their orbits can be utilized to provide a suitable medium for navigation, and we can devise a motor sufficiently powerful—and scientists have been working for years to master the mystery of radium emanations, the most powerful thing yet discovered—may not such a trip become possible?—*Photos courtesy of the Bray Productions.*

Transparent Paper

FOR over fifty years chemists and paper manufacturers have been actively engaged in the production of transparent paper. Some of the processes used by these investigators involved impregnating the paper with all sorts of substances, such for instance, as fats, oil, resins, gums, and other similar compounds. Several years ago a paper, entitled Glassine, appeared on the market. This paper, as well as those paper resulting from the treatment with the products mentioned, was not transparent, but rather translucent. Furthermore, the use of such papers is more or less limited, inasmuch as they have a tendency to impart an odor or greasiness to the object with which it is wrapped.

Recently, a Milwaukee manufacturer has brought on the market a perfectly transparent paper, without taste, odor or greasiness. In fact, this paper has some remarkable characteristics that make it superior to celluloid in some respects. The new product is sold in various grades of hardness, thickness and other physical grades, as it may find application in the market. The paper is known as "Cellulin." Some of the grades are as thin as ordinary tissue paper (.001/2) and intended for wrapping purposes, such for instance, as candy, fancy boxes, food stuffs, window-envelopes, sausage casings, etc. Whereas, the thicker grades are used for the same purposes as celluloid, in fact find ready application for the manufacture of the ordinary motion-picture films, automobile curtains, etc. Cellulin is preferred to celluloid because of the fact that it is cheaper; furthermore, it is not so readily combustible as is celluloid. Cellulin is not soluble in water, nor is it affected by the organic solvents that celluloid or similar products are soluble in. The heavier grades (.005) are absolutely non-inflammable, and the peculiar yellowish cast is absent in Cellulin.



A German engineer has devised this gigantic scheme for utilizing the free power of the wind, two of his designs for huge electric plants driven by wind wheels, being shown in the accompanying illustration. The rudder attached to the frame causes the wind wheels to face into the wind with changes in its direction, the frame itself being free to revolve on wheels running around a circular track. All of the wind vanes are geared to a common shaft driving a series of dynamos through automatic clutches, the proper sized dynamo for a given wind power being automatically thrown into service, in order to realize the maximum efficiency with this type of generating plant.

A Giant Wind-Power Plant

IN countries where water is not always available for the production of power, and even the rivulets dry up, or in which due to geological and topographic conditions the flow of water is very slight and dams cannot readily be built, other methods of obtaining power without using coal must be employed. Electricity produced from coal is subject to limitations, because in the course of time coal mines will be exhausted. Coal mining is also a rather expensive procedure, and transportation charges bring up the price of coal considerably, as do strikes among miners and railroad operators.

Air currents on the other hand form a most reliable and inexhaustible source of power, even though the speed of the wind rises and falls, decreasing almost to zero at times, and increasing to a gale at others, and although small wind-driven generators are being employed for producing electrical energy on farms, these plants are not as economical and efficient as large wind motors, having many fan wheels arranged side by side, one row above the other, and one group behind the other on a structure capable of withstanding heavy wind velocities, transmitting the accumulated power to a common shaft.

A German engineer, Herr Carl Ludwig Lannenger, has shown how such giant wind motors could be employed for producing electrical energy in large quantities. Not only could they be erected on windy beaches, but also in the inland regions or on hills or wide flat grounds. The individual fan wheels on such large motors would vary in diameter from twenty to forty feet, with an extreme diameter of possibly fifty feet. In the illustration two of these giant wind power machines are shown. In the foreground is a wind mill which has three rows of fan blades arranged, one above the other, and another set, exactly identical backing this. There are, therefore, six rows of these immense air wheels.

The entire structure rotates on a structural central upright, a large vane serving to direct the bladed wheels into the wind. The end of this rotating structure likewise turns on rollers, which bear on a circular track. In the background we see another power plant of a similar nature, having only one double row of fans. This is a smaller power station, and it will be seen that the structure here revolves on the center upright, having no additional braces and no circular tracks, as in the case of the aforementioned power producing devices.

Now, usually the velocity of the wind on beaches and in the inland regions varies in speed from three to eighteen miles per hour, but because of the variation of speed corresponding as it does to a definite number of revolutions of the power shaft, and also to a definite torque, the giant wind motor does not drive only one dynamo for charging the accumulators, as in the case of small wind-driven generators. In the large central stations, the changing forces of the wind are classified in certain groups, and for each group a corresponding dynamo, which is automatically switched into or out of the circuit, is employed. For this reason, the highest efficiency of the dynamo is obtained at any given speed or power. As no generator will develop its maximum amount of power, unless driven at a certain speed, and if a generator is designed so that it can operate efficiently on one of the speeds, a governor must be employed to cut down

(*Continued on page* 1017)

May

25 cen

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER

THE AUTOMOBILE OF 1973

See Page 26

MONEY FOR YOUR IDE

An Under-Sea Pleasure Trip

"RIGHT this way. The famous ride into Neptune's domain. ride through and under the sea. Only twenty cents, a fifth part of a dollar." This cry greeted us as we were passing along a road skirting the beach at one of the favorite summer resorts. Our attention was attracted by the crier's call to a large sign, "Ride Through the Sea Below the Level of the Waves," and surrounding this colored posters could be seen showing sea serpents, fish and corals in artistic combinations. Here on another poster we found a wreck of some old frigate. It lay as a skeleton, its ribs extending upwardly from its sandy grave; an octopus had entwined one of its tentacles around one of the ribs. A fantastic picture of the Sea Sled, the conveyance which was daily taking passengers into the kingdom below the level of the sea, was also shown.

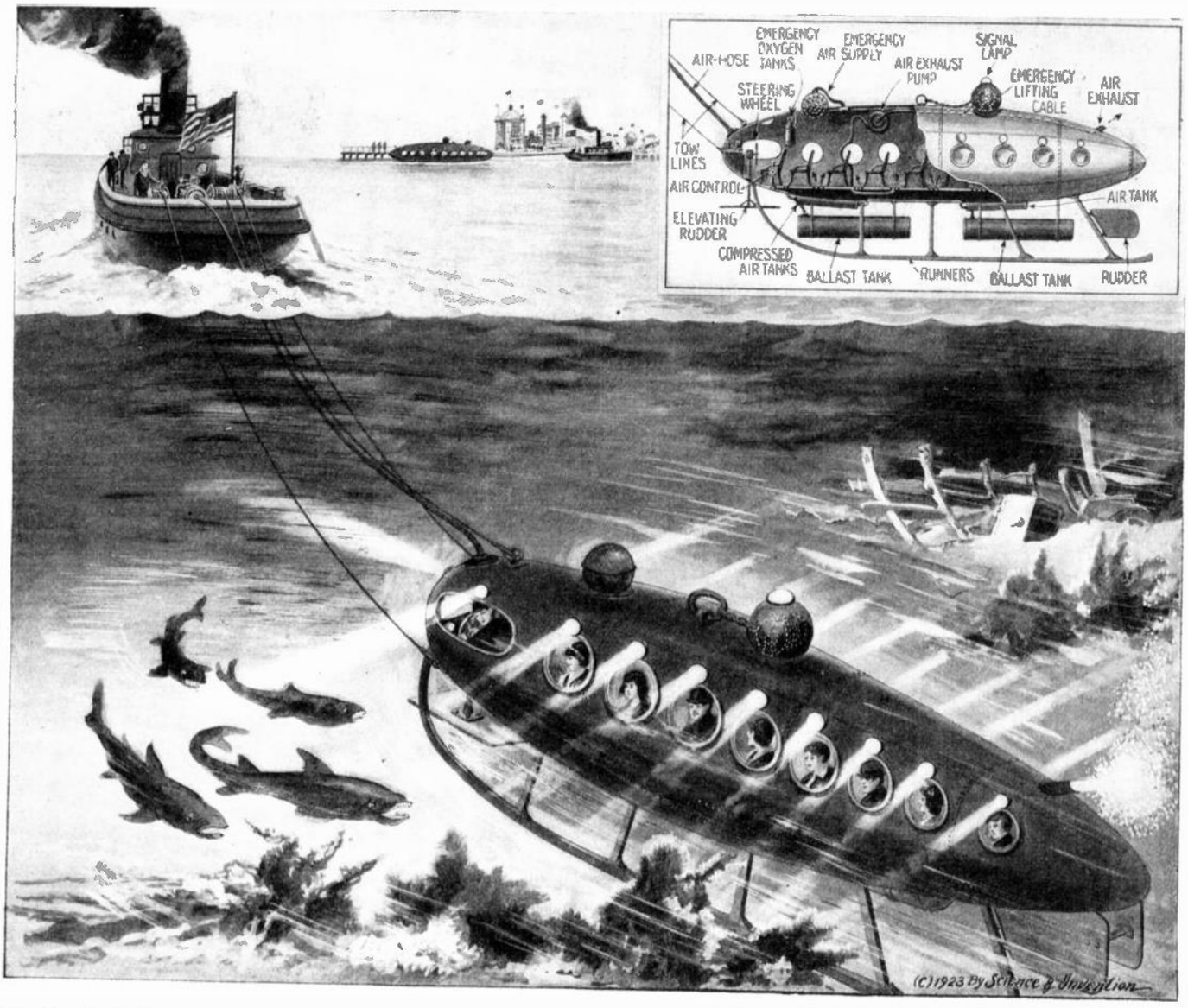
Having purchased our tickets we passed down to the end of the pier, where a large raft already crowded with expectant visitors was awaiting the arrival of the next sub-sea sled. Soon a speedy tug boat hove in sight. As it reached the shallow water, we saw emerging from the depths a large body coming up like the nose of a whale and elongated itself as it emerged from beneath the waters. It was towed alongside of the raft, a water-tight door opened, and an elated group of passengers left the submarine, a sort of car body carried on sled-like runners.

Many passengers remained for a second ride, and it was not until two or three subsequent trips had been made, that we finally found room to enter the water-tight compartment. Once inside we positioned ourselves close to the operator, so that we could the more readily understand the various constructional details of this Sea Sled.

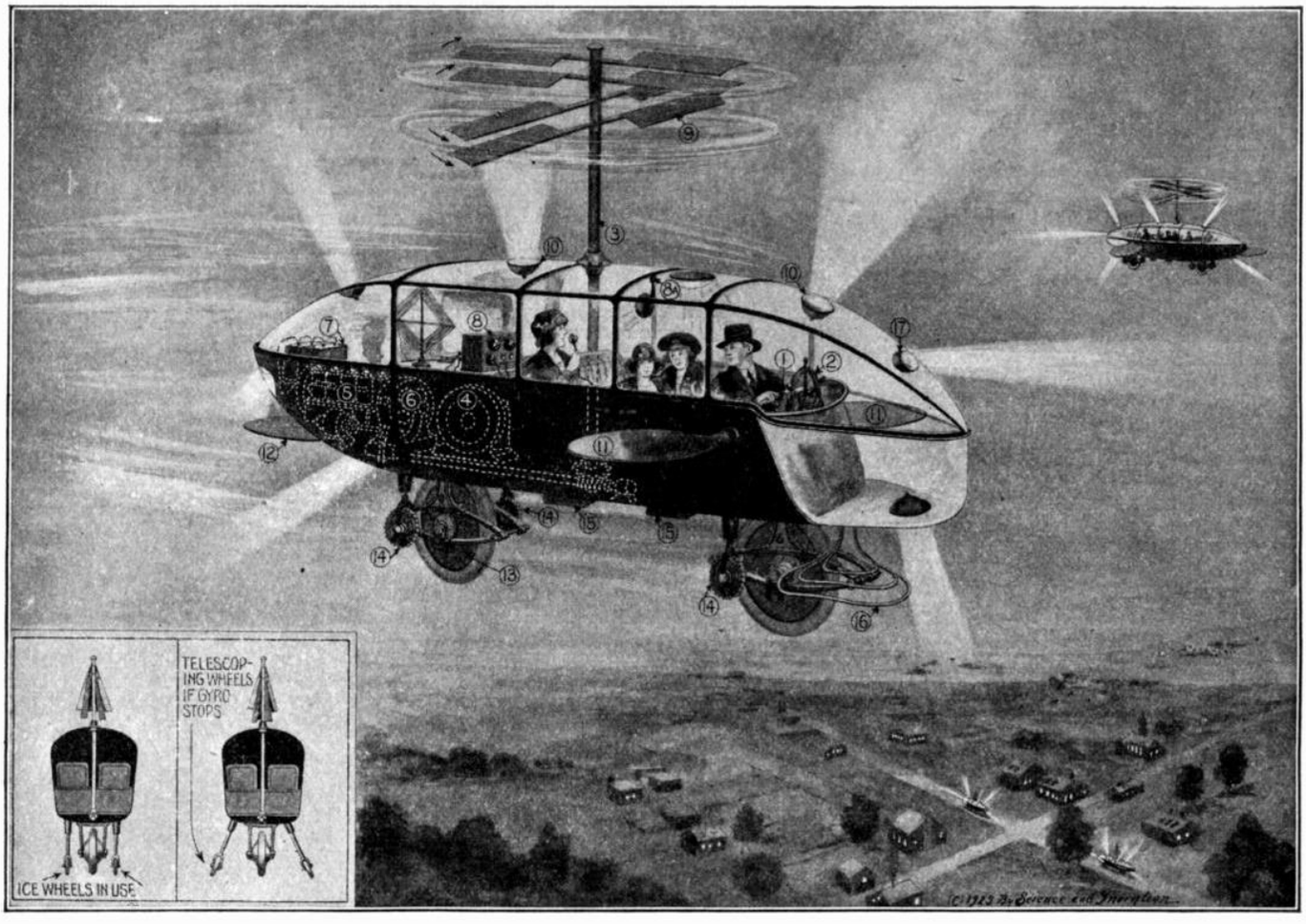
The submarine-like body was mounted on sled runners, and the sled was fitted with elevating rudders as well as horizontal rudders. It was devoid of any power, but was towed along the bottom of the sea by a tug or motor boat; two towlines passed from the tug boat to the sled. The operator in the sub-sea vessel kept his eye on the tug boat on the surface, and directed the sled as he would an automobile towed by another. Whenever a rock or other projection rose from the bottom of the sea, he simply drew his steering wheel toward him, causing the elevating rudder to be raised, whereupon the sea sled left the bottom. In doing so, the passengers experienced a delightful rocking sensation.

Ballast tanks were located near the bottom of the sled, and an air hose leading to compressed air tanks located in accessible positions between the runners, served to blow out these ballast tanks in case of accident. The amount of water in the tanks was automatically controlled by the weight of the passengers within the sled. This automatic control permitted the sled to be towed along the ocean's bottom very easily, the friction being practically eliminated, due to the very slight amount of negative buoyancy which the sled possessed. This negative buoyancy was further reduced by the action of the elevating rudder in the

(*Continued on page 67*)



The "Sea Sled" Shown in the Illustration Above is the Latest Idea in Amusements for Sea-Side Summer Resorts. It Gives the Spectators the Greatest Thrill Possible Without the Slightest Element of Danger.



THE "HELICAR" OF TOMORROW—IT FLIES OR TRAVELS ON ROAD

1—Push Button Power Control Board Before Driver, Which Also Switches Power to Helicopter Drive Shaft 3, and Blades 9, When it is Desired to Fly.
2—Steering Wheel.
3—Helicopter Drive Shaft.
4—Gyroscope for Stabilizing Car on Two Wheels.
5—Twelve Cylinder Gasoline Engine Driving Large Dynamo 6, Which Supplies Electric Current to Motor Within Rear Wheel, 13.
7—Storage Battery for Engine and Radio Receiving and Transmitting Set, 8.
9—Collapsible Helicopter Blades. (Note: Engine Driven.)
10—Powerful Electric Lamps and Reflectors for Flying Purposes.
11—Elevating Wings Controlled by Driver, Used in Ascending or Descending, as Well as Tail, 12.
13—Electric Motor Wheel Which Drives Car Along Road.
14—Motor Driven Spur Wheels Which Can Be Lowered to Assist in Propelling the Car Out of Icy Spots.
15—Collapsible Steps.
16—Fender.
17—Electric Headlight Used When Running on Road.

The Automobile of 1973

By H. GERNSBACK

MEMBER OF THE AMERICAN PHYSICAL SOCIETY

THE modern automobile, as far as the public is concerned, is only about 25 years old. It is true that a few cars were made as much as 30 years ago, but these were not for universal use, and only millionaires could afford them. The first cars were very crude, and were not at all reliable, and when we look back upon these high-wheeled two-seaters we smile at the contraptions that they were.

The other day an automobile of that early vintage rolled down Broadway. It was running under its own power, but the sight was so ludicrous that it stopped all traffic, and every one had a good laugh at this piece of ancient mechanism.

25 short years were enough to produce this result. What, then, may we expect to see 50 years hence? What sort of automobile will we ride in? What will be commonplace 50 years hence?

The automobile, as it is built now, tends to become larger and larger. The car of today is fully three times as large as the car of 25 years ago. In our large cities overcrowding, due to the tremendous number of automobiles, has now reached the saturation point. New York City is about to enact a law to eliminate a certain number of taxicabs, which now crowd the streets to such an extent that it is impossible to make any time at all in certain sections of the city. If you really wish to move rapidly, you have to take the subway or the elevated railway. This condition exists in most large cities. It has been proposed to build viaducts over the house tops, but due to the high cost it is doubtful if such a plan will ever become a fact, even in a time remote from now.

The only practical solution is to combine the automobile with an airplane and this no doubt will happen during the next few decades. The Helicopter Automobile or, for short, the *helicar*, will not take up very much more room than the present large 7-passenger automobile, nor will it weigh much more than our present-day car, but instead of rolling down the avenue, you will go straight up in the air, and follow the air traffic lines, then descend at any place you wish. This descent can be made in the middle of the street, if necessary. The car may roll through the street, and may rise in an open place, or square, of which there will be many in the future.

While it will be possible for a car to alight on the ground in a narrow street, traffic regulations may prohibit this, and the aerial ascent and descent will be made from these public squares or parks. The Helicar will be particularly useful for suburbanites to fly to and from work, and for pleasure. Even today our roads, whether they be suburban or country, are so clogged with traffic that it is impossible to get anywhere on time.

Our front cover illustration shows the Helicar moving through one of our future streets, as an automobile, while the illustration on this page shows the Helicar as a flying machine.

It will be noted that only two wheels are used. Two wheels are more economical than four. There is less trouble with gears and shafts, and this construction decreases the weight of the car as well. A gyroscope keeps the car in an upright position at all times, and makes riding on two wheels perfectly safe.

Two-wheel vehicles are not new, as witness the bicycle. The famous Englishman, Brennan, has already tried them out, and there will be no reason for using four wheels in the future.

December

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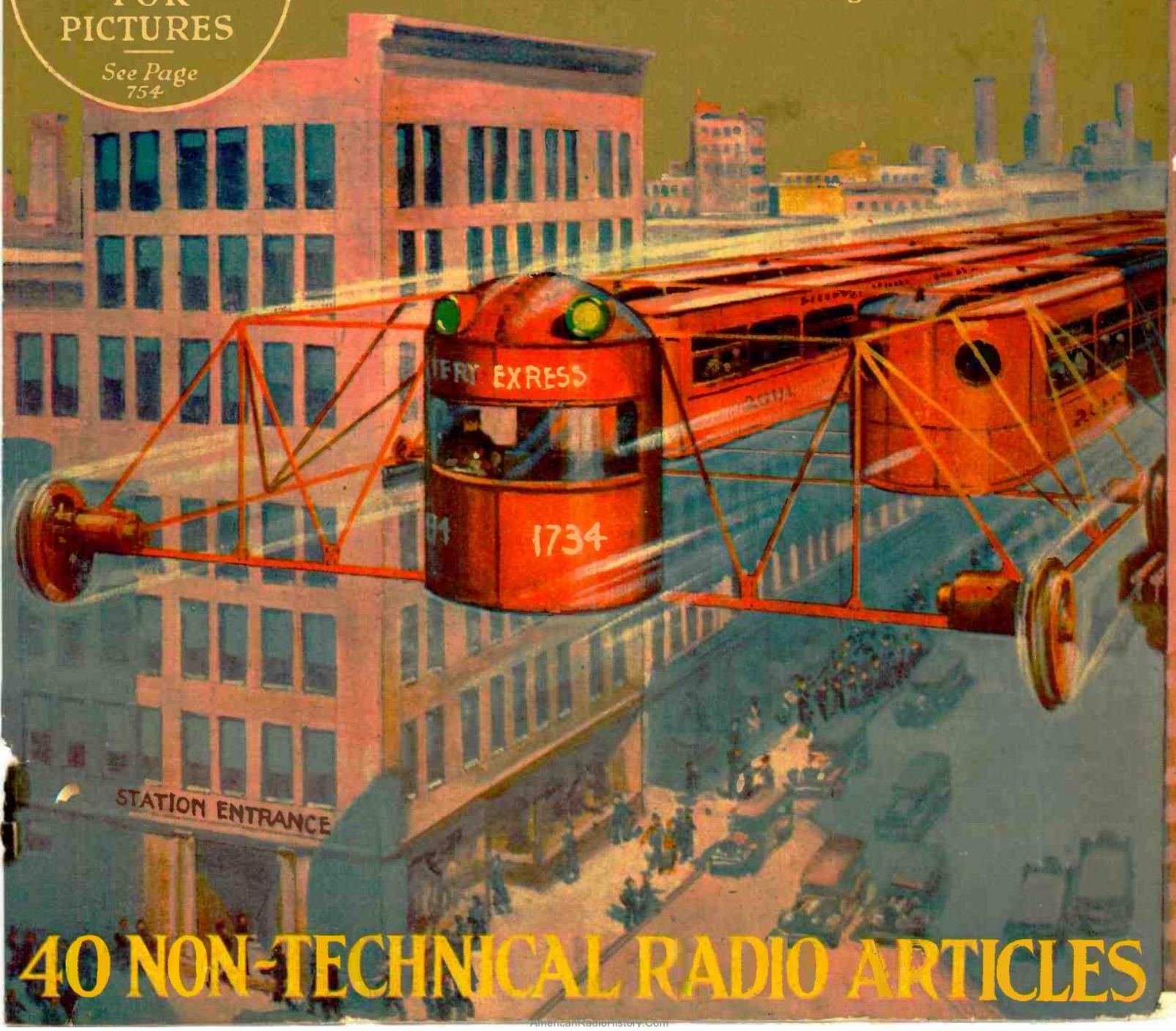
See Page 754

A "FLOATING" RAILROAD

See Page 753



40 NON-TECHNICAL RADIO ARTICLES

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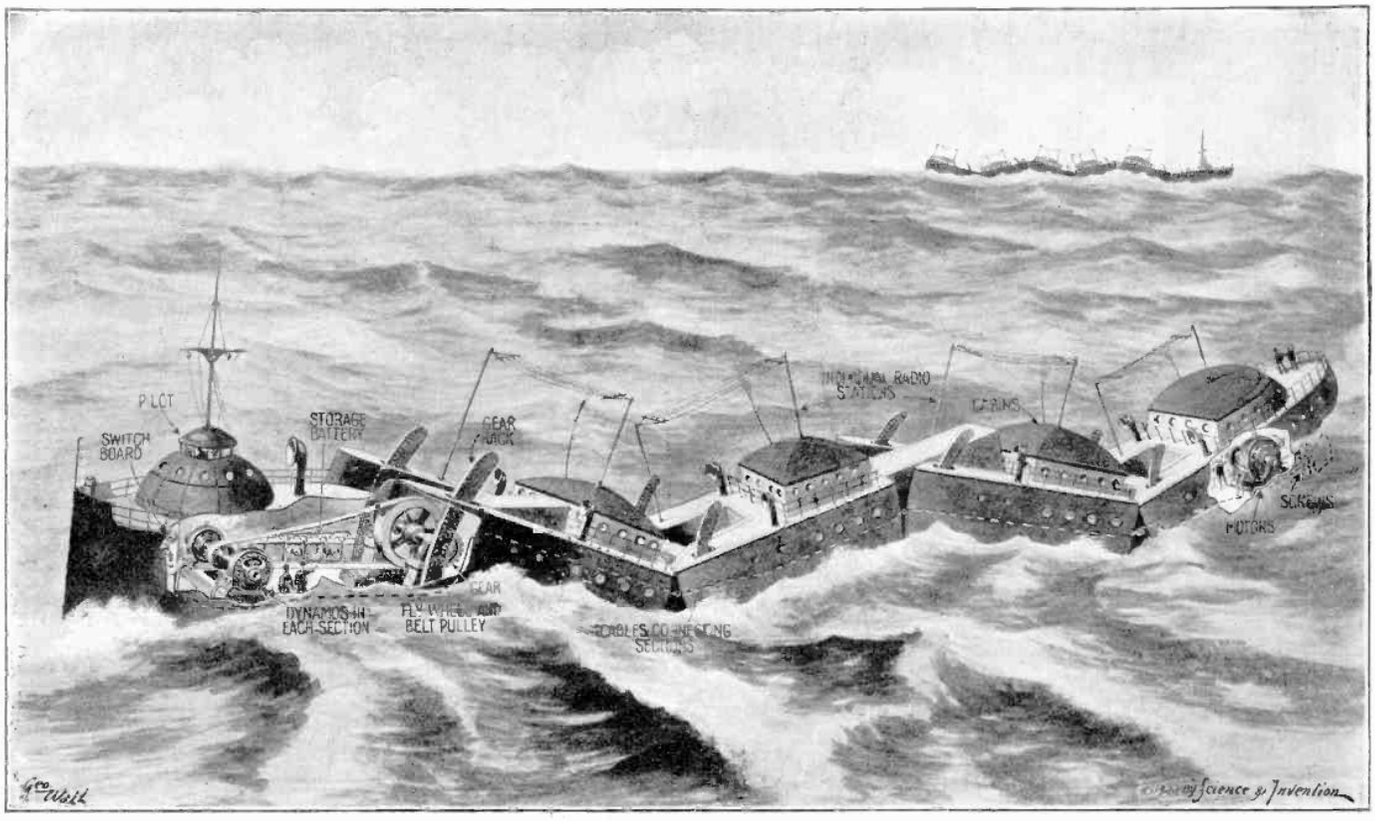
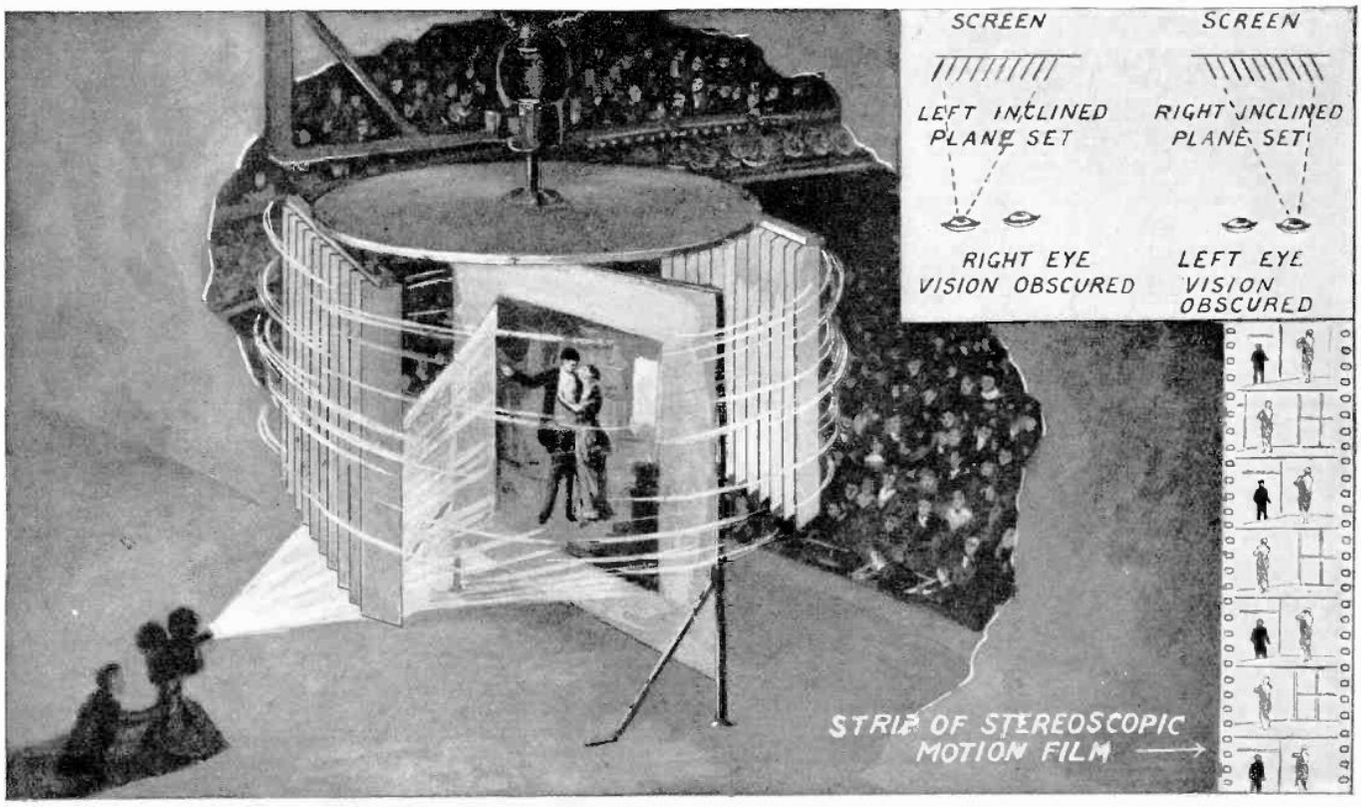
Self-Propelling Wave Ship



The ship shown in the illustration above is built in sections so that they rock up and down with the motion of the waves. This motion runs electric generators in each section. The current generated in this way is carried to the rear of the ship where it runs motors connected with the propellers thereby propelling the ship. There are storage batteries also that collect the surplus current so it may be used when the sea is quiet. The gears are made so that both the up and down motion of the waves are used.

Stereoscopic Motion Pictures



By means of revolving shutters that pass before the screen an English inventor has found a means of producing stereoscopic movies—movies in which the figures stand out in bold relief as they do naturally. The special film used with this method is taken with a stereoscopic movie camera that exposes one side for one frame and the other for the next. The revolving shutters that allow the scenes to be viewed first with the right eye and then the left works in synchronism with the camera. The projector is behind the transparent screen.

—Cedric Marshall.

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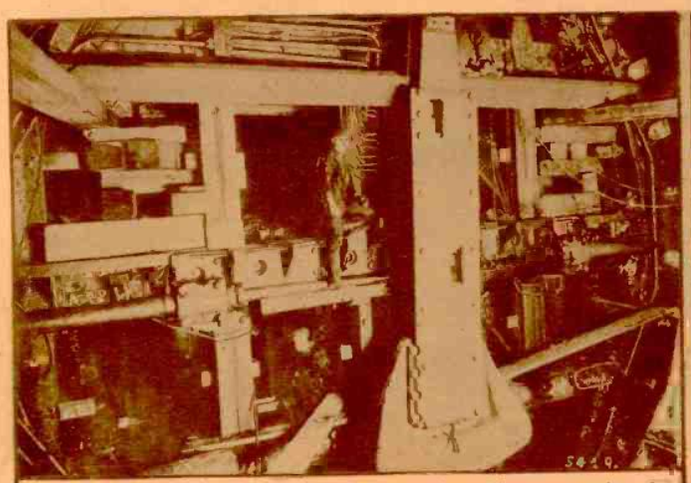
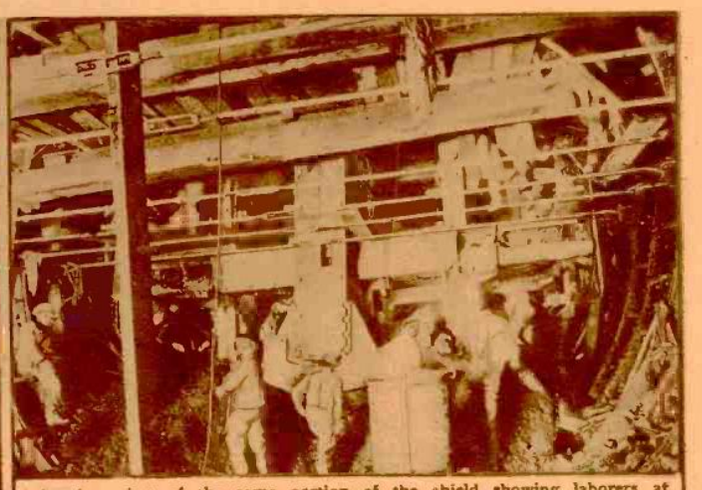
Largest Vehicular Tunnel

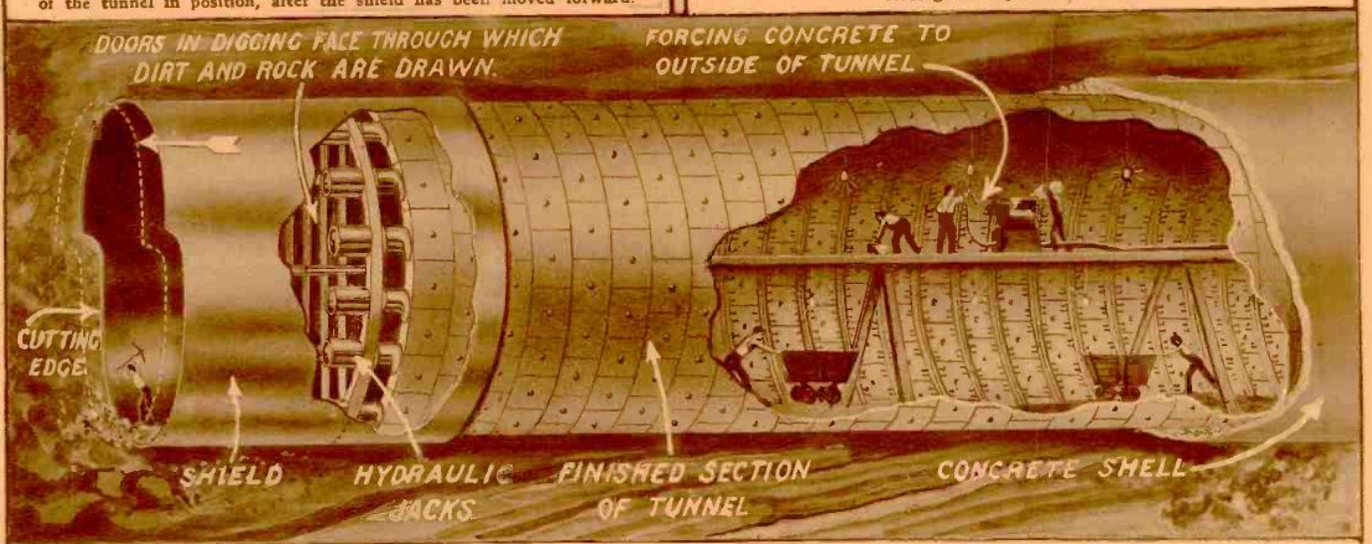
By A. P. PECK



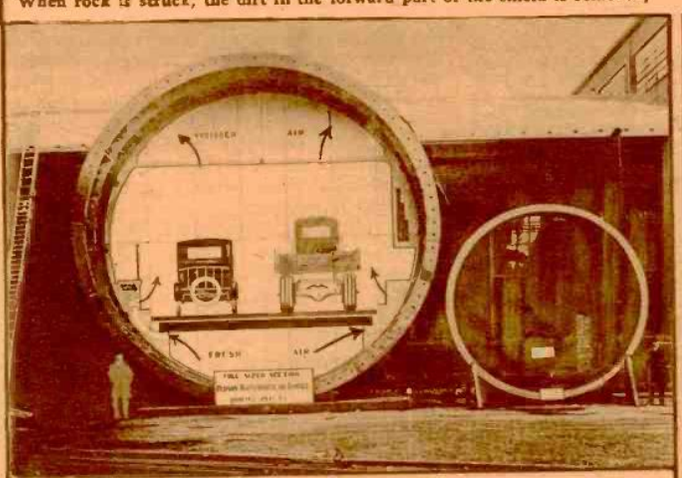
A rear view of the digging face of the shield used in constructing the New York-New Jersey vehicular tunnel under the Hudson River is shown above. The jacks which are used to force the shield ahead may be seen at the side. The large upright arm is used to place the sections of the tunnel in position, after the shield has been moved forward.



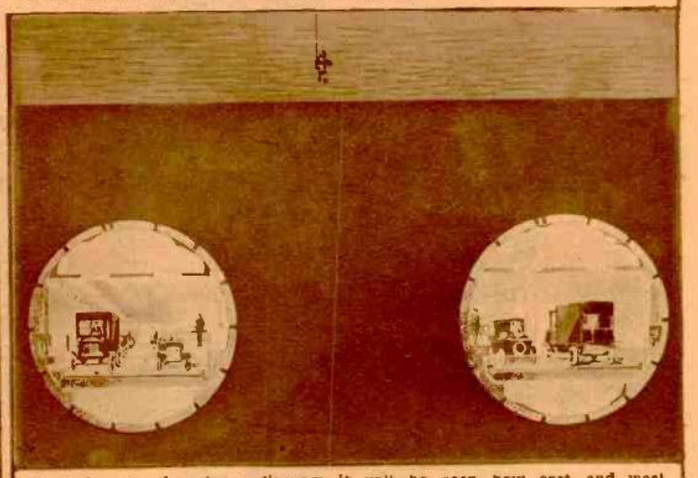
Another view of the same portion of the shield showing laborers at work digging through the doors in the face. These men work under an air pressure of twenty-nine pounds per square inch. Occasionally it is necessary to increase this pressure in order to keep the earth from forcing its way into the tunnel.



A diagrammatic view of the shield and a finished section of the tunnel will be seen above. The hydraulic jacks force the shield forward and the dirt and rocks are removed through the finished tunnel after being taken in through the digging face.
When rock is struck, the dirt in the forward part of the shield is removed, and blasts are set to break up the rock. The concrete shell, in semi-liquid form, is forced out under air pressure through holes in each section of the steel wall. When the shield can be forced forward by the jacks this is done until the shield has advanced. Then two or three jacks are removed and a steel section is set in place.



At the left is shown a cross-section of one of the finished segments of the steel tunnel. The system of ventilation can be plainly seen. To the right is shown a section of what was formerly the largest under-river railroad tunnel in the world. The pleasure car and truck indicates how fast and slow moving vehicles will be divided to prevent congestion.



Referring to the above diagram it will be seen how east and west bound traffic will be taken care of by the twin tubes under the river connecting New York and New Jersey. Note the depth of the tubes below the river bed and their distance apart. Pedestrians are taken care of by the walks on the sides. Fresh air will circulate in the tubes.

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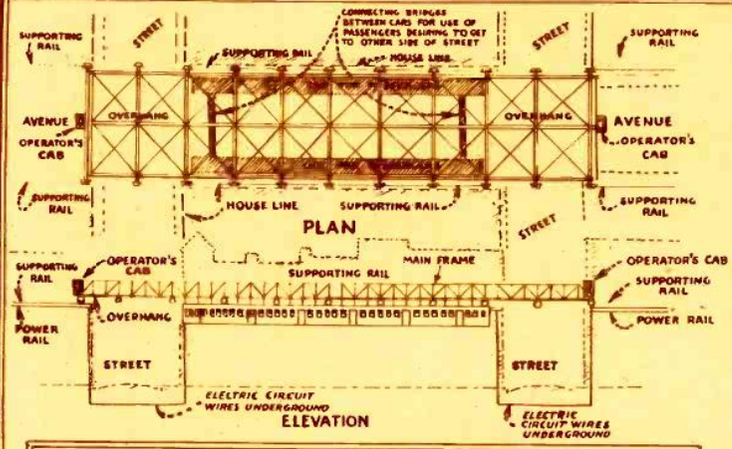
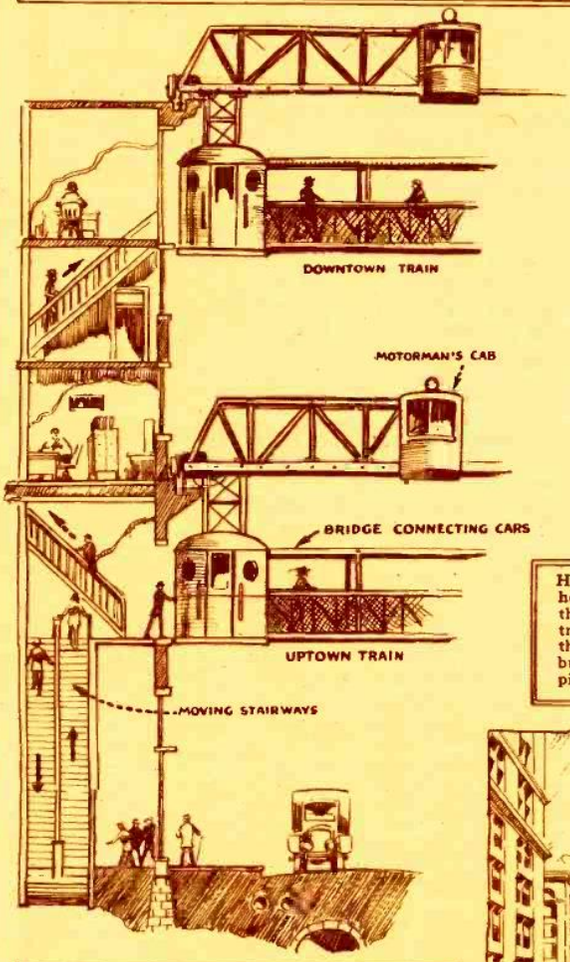
Invisible Elevated Railway

Carrying Structure in Buildings at Side of Street.

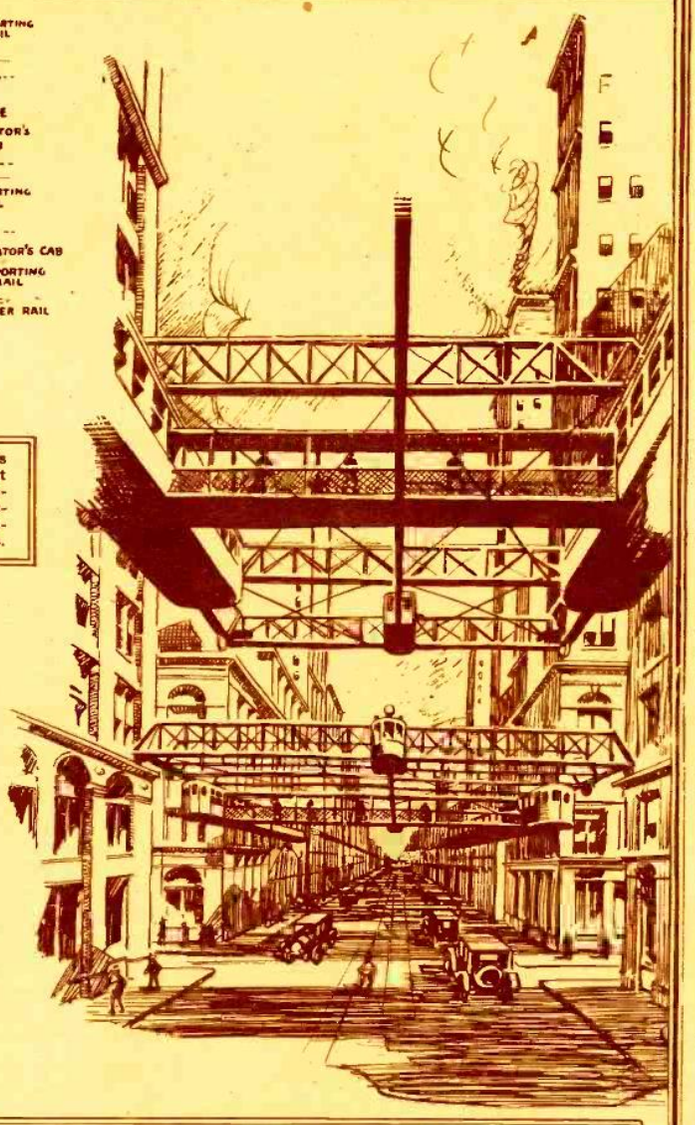
BY EDWIN F. LINDER



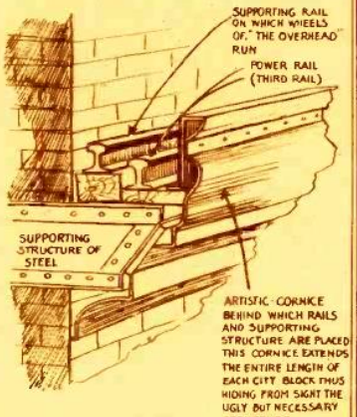
A plan view of the new idea in elevated railroads. The supporting rails are built into and supported by the steel work of the buildings that line the street. Cornices cover them from view. The trains are supported on a long, rigid framework that carries them over the street crossings without additional supporting bridge work. The overhanging running frame is extended at each end enough to cross the street gaps.



The stairways to and from the trains are also housed in the buildings at the side of the streets. The trains in one direction will run on one level and those in the other direction will run on the level above. The passenger cars will be suspended below the carrier framework on both sides near the houses. Gangways will connect the cars in the center. Passengers can board cars from both sides.



How trains running in opposite directions will look approaching each other. Note how the carrying structure protrudes in the front of the train to carry it over the street crossings. Below at the left is a view of the same street after the trains have passed. Below at the right is a close-up of the arrangement of the carrying and power rails resting on beams hidden within the walls of the buildings, thus leaving the street clear of the unsightly net of iron work and pillars that are used today to support the trains. Service will also be faster.



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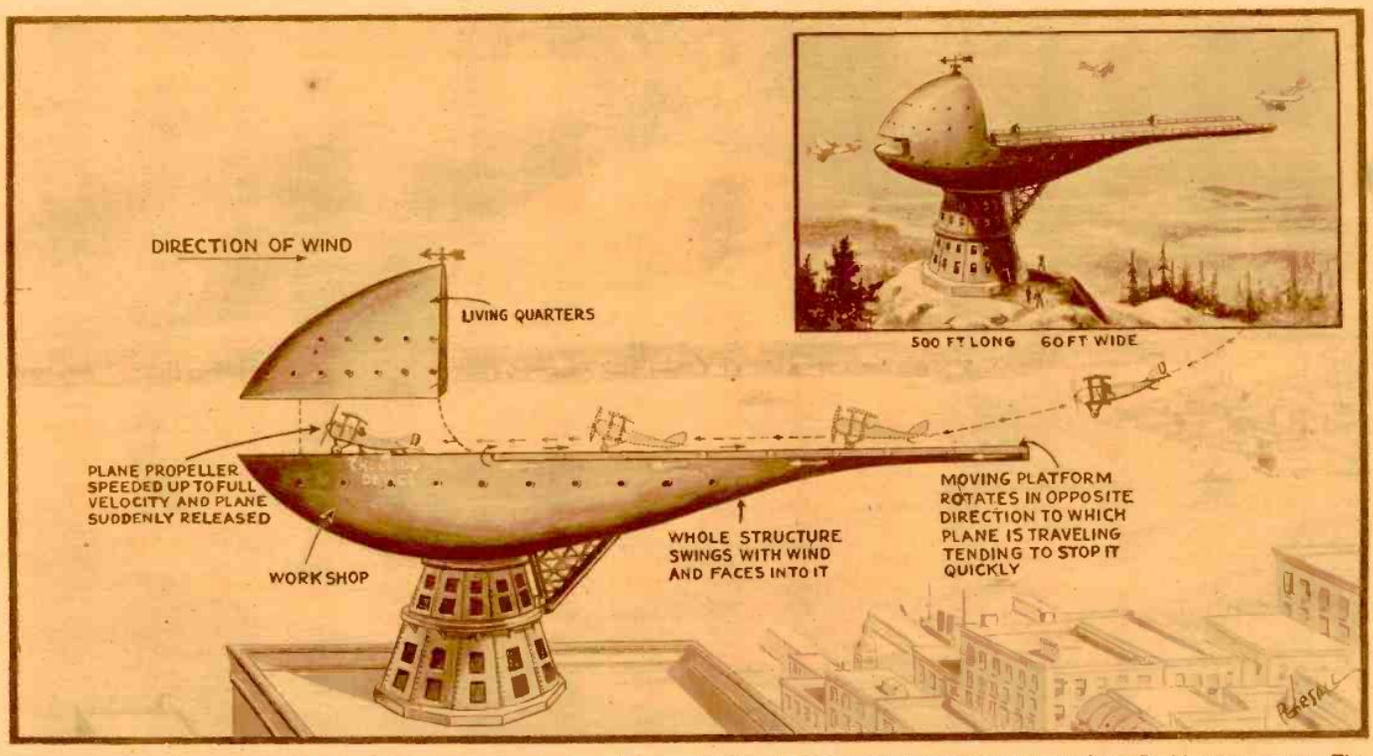
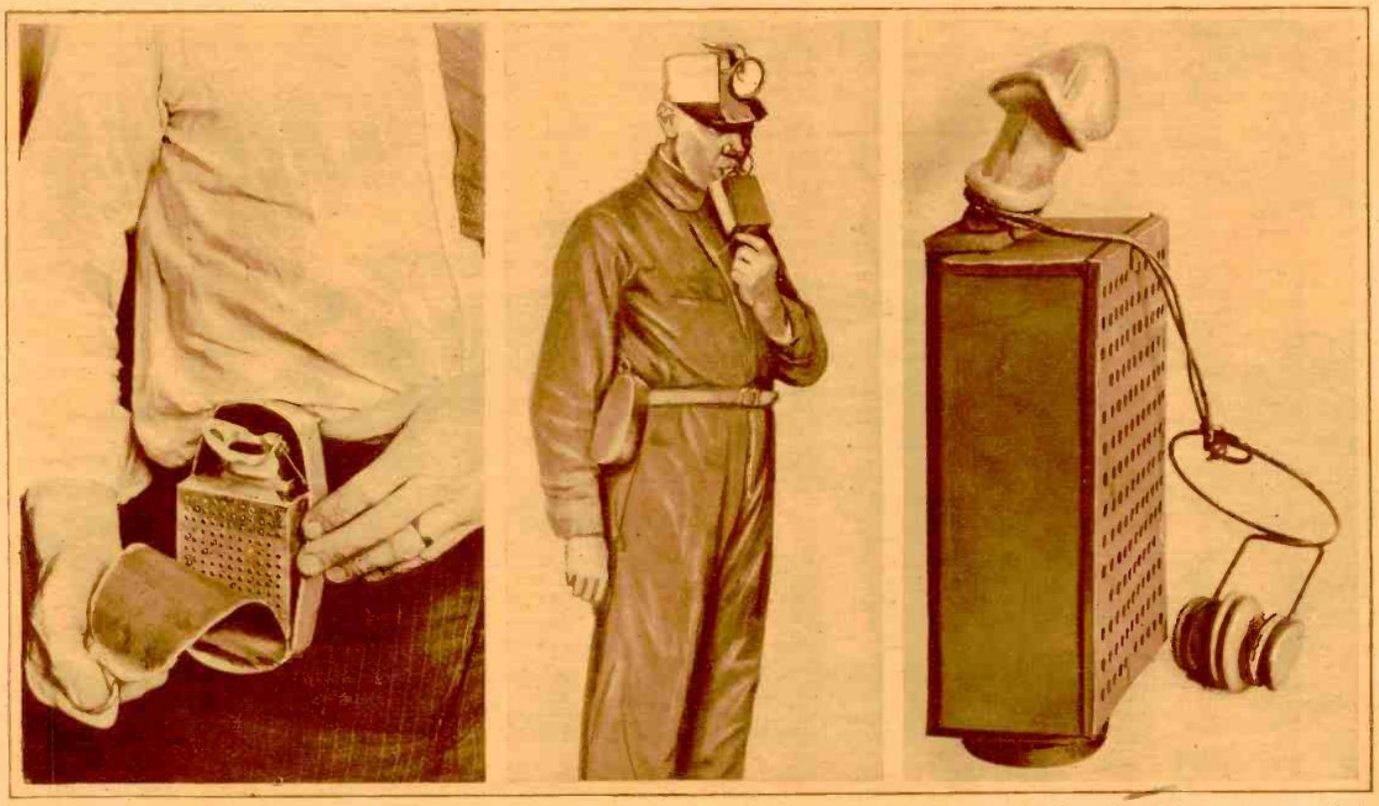
Airplane Landing Stage

By GEORGE F. PAUL



The new landing stage shown in the above drawing can be constructed anywhere, regardless of physical conditions surrounding it. It will accommodate landing in any weather and allows planes to hop off without a runway. The structure is of fabricated steel and automatically faces itself into the wind.

Safety Gas Mask for Miners



The gas mask shown above was found to be very effective against poisonous mine gases. Ordinarily it is carried in the small metal container shown at left. For use the miner clamps tips over his nose and grips mouthpiece with his teeth. The perforated box contains hopcalite which counteracts carbon monoxide, the most deadly of mine gases. The chemicals will give relief for seventy minutes, allowing miner time to reach safety.—John M. Schalek.

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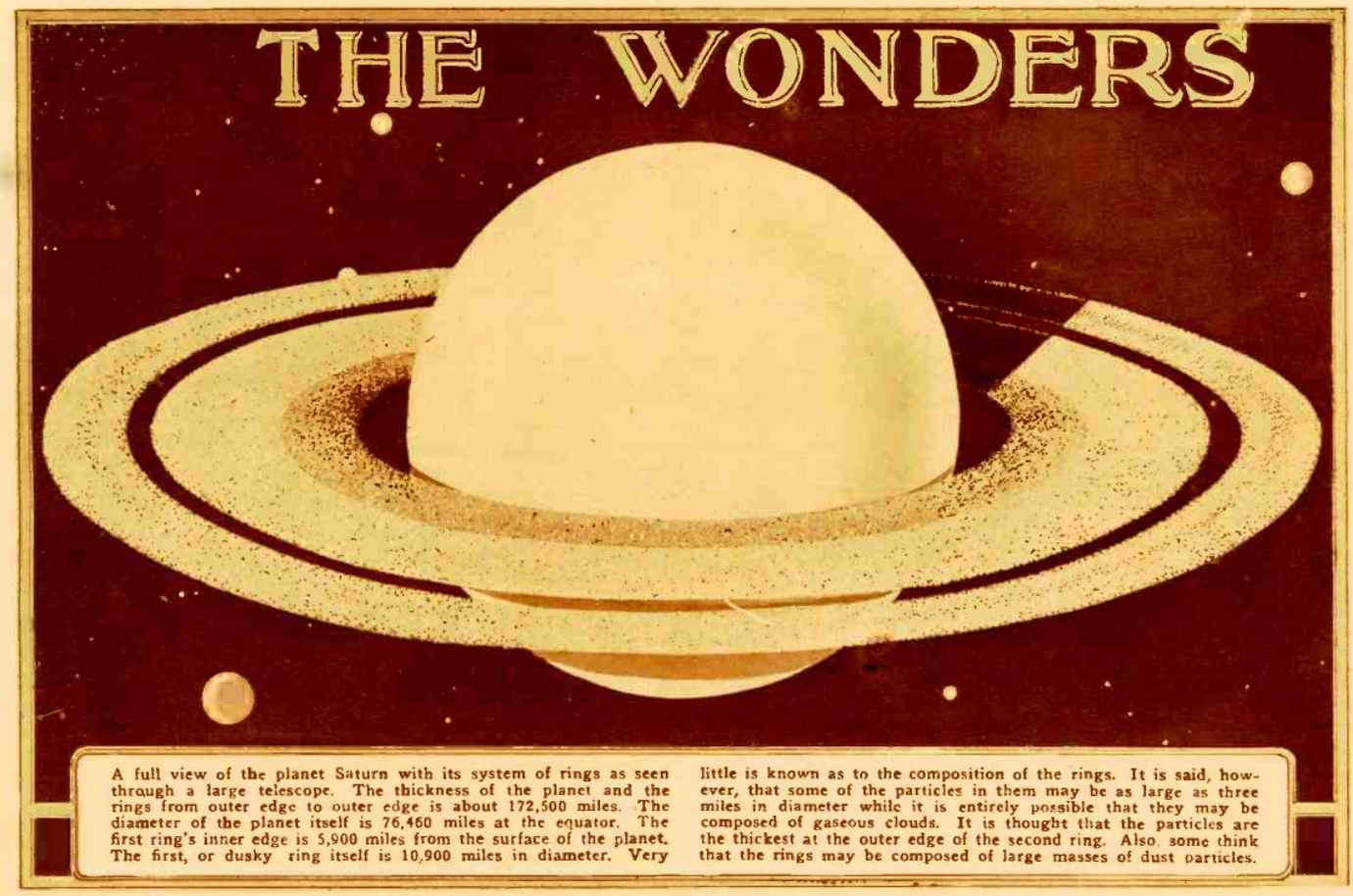
POPULAR

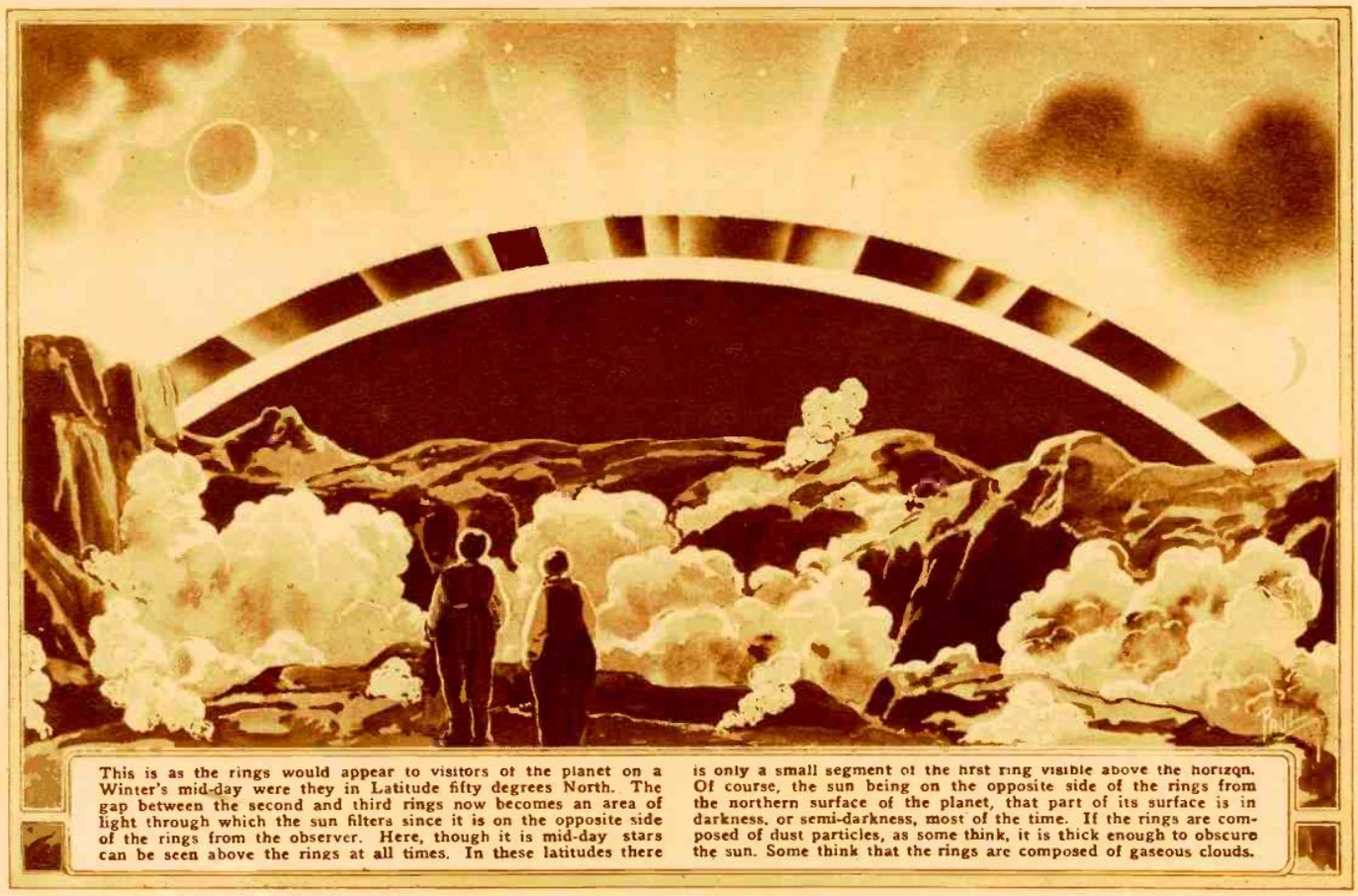
BY ISABEL

OF THE U. S.

THE WONDERS



A full view of the planet Saturn with its system of rings as seen through a large telescope. The thickness of the planet and the rings from outer edge to outer edge is about 172,500 miles. The diameter of the planet itself is 76,460 miles at the equator. The first ring's inner edge is 5,900 miles from the surface of the planet. The first, or dusky ring itself is 10,900 miles in diameter. Very little is known as to the composition of the rings. It is said, however, that some of the particles in them may be as large as three miles in diameter while it is entirely possible that they may be composed of gaseous clouds. It is thought that the particles are the thickest at the outer edge of the second ring. Also, some think that the rings may be composed of large masses of dust particles.



This is as the rings would appear to visitors of the planet on a Winter's mid-day were they in Latitude fifty degrees North. The gap between the second and third rings now becomes an area of light through which the sun filters since it is on the opposite side of the rings from the observer. Here, though it is mid-day stars can be seen above the rings at all times. In these latitudes there is only a small segment of the first ring visible above the horizon. Of course, the sun being on the opposite side of the rings from the northern surface of the planet, that part of its surface is in darkness, or semi-darkness, most of the time. If the rings are composed of dust particles, as some think, it is thick enough to obscure the sun. Some think that the rings are composed of gaseous clouds.

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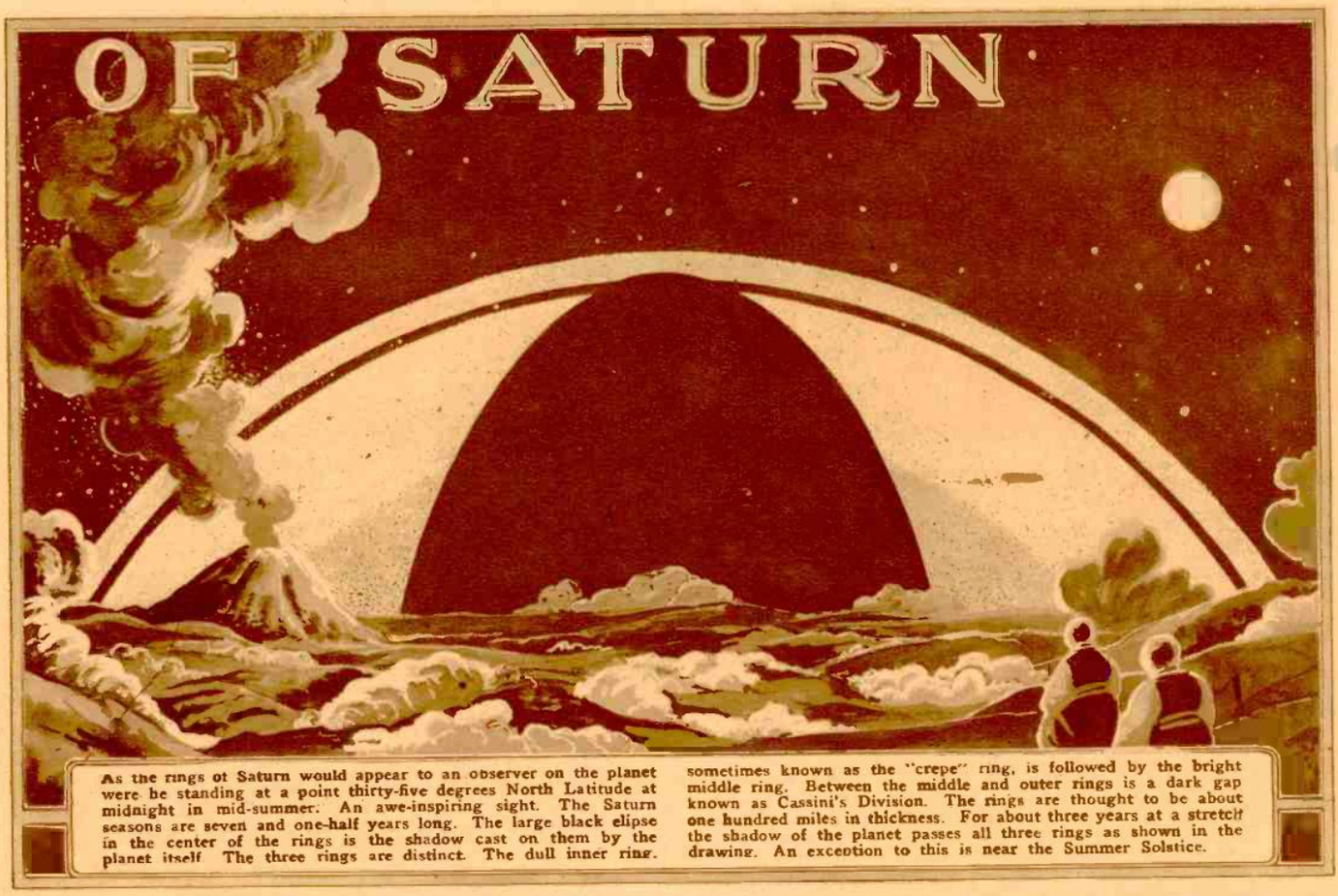
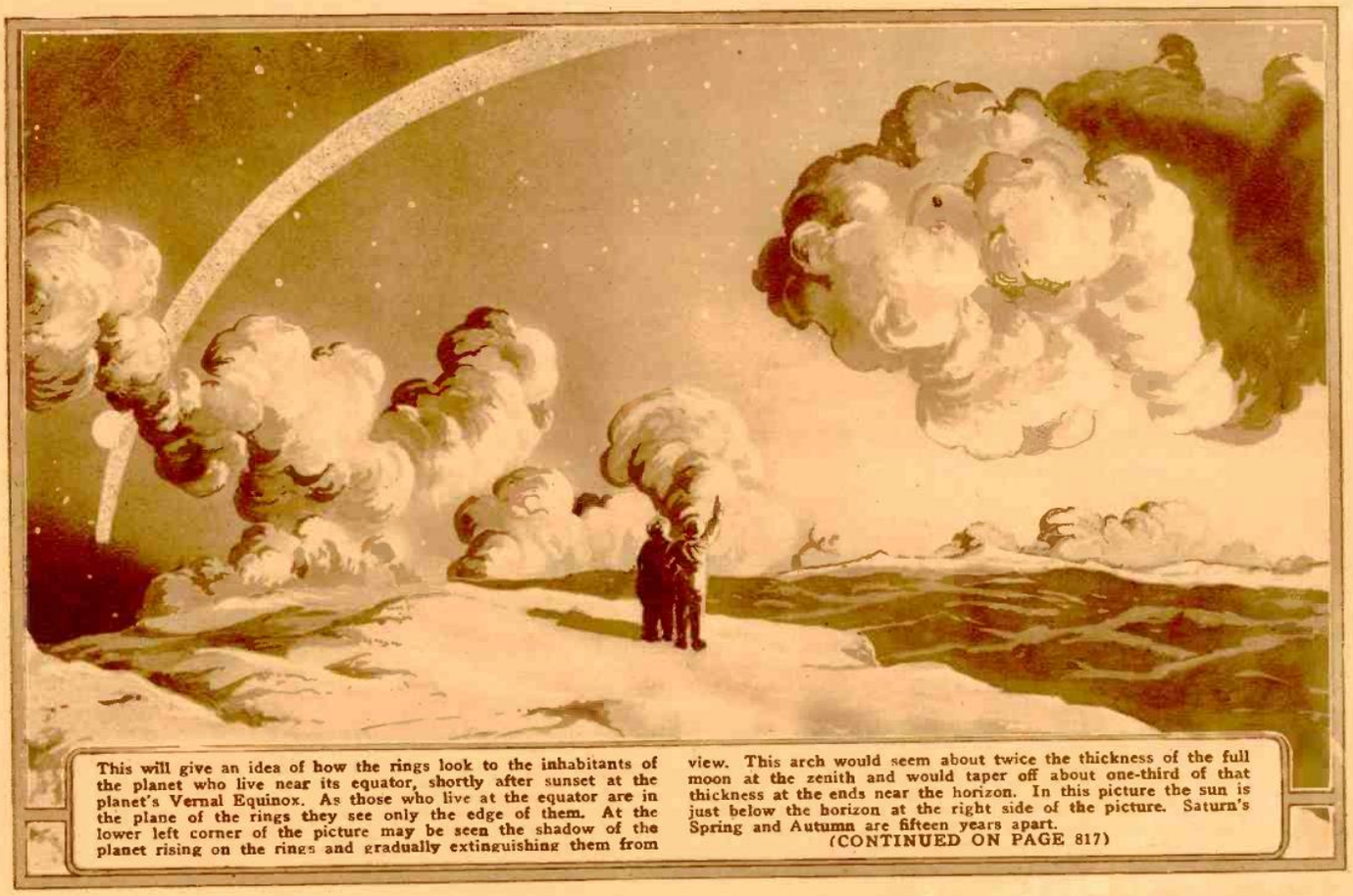
ASTRONOMY

M. LEWIS, M. A.
NAVAL OBSERVATORY

OF SATURN



As the rings of Saturn would appear to an observer on the planet were he standing at a point thirty-five degrees North Latitude at midnight in mid-summer. An awe-inspiring sight. The Saturn seasons are seven and one-half years long. The large black elipse in the center of the rings is the shadow cast on them by the planet itself. The three rings are distinct. The dull inner ring, sometimes known as the "crepe" ring, is followed by the bright middle ring. Between the middle and outer rings is a dark gap known as Cassini's Division. The rings are thought to be about one hundred miles in thickness. For about three years at a stretch the shadow of the planet passes all three rings as shown in the drawing. An exception to this is near the Summer Solstice.



This will give an idea of how the rings look to the inhabitants of the planet who live near its equator, shortly after sunset at the planet's Vernal Equinox. As those who live at the equator are in the plane of the rings they see only the edge of them. At the lower left corner of the picture may be seen the shadow of the planet rising on the rings and gradually extinguishing them from view. This arch would seem about twice the thickness of the full moon at the zenith and would taper off about one-third of that thickness at the ends near the horizon. In this picture the sun is just below the horizon at the right side of the picture. Saturn's Spring and Autumn are fifteen years apart.

(CONTINUED ON PAGE 817)

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February

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THE NEW Science and Invention

IN PICTURES

THE SUBMARINE-LAND DREADNAUGHT

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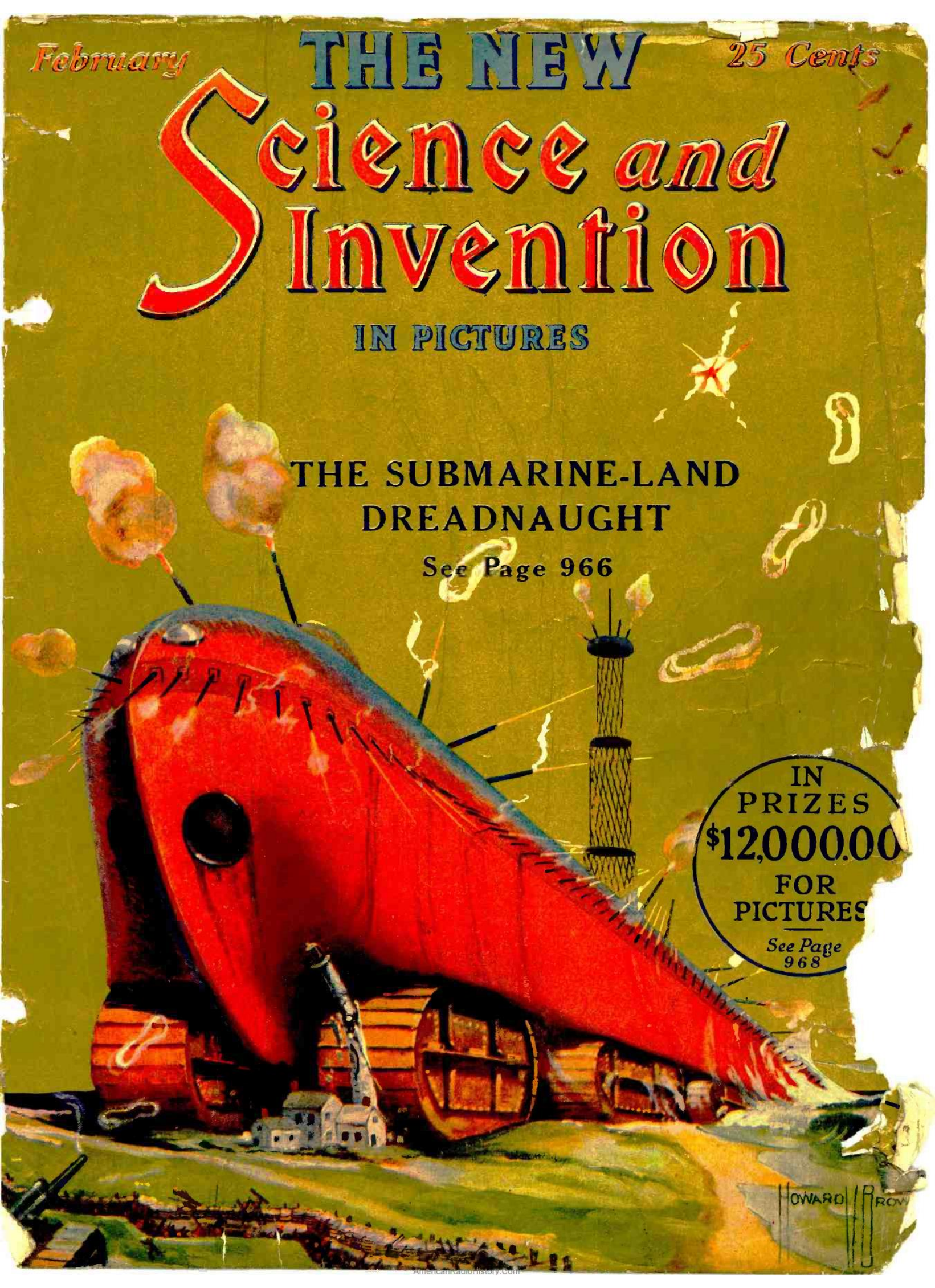

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See Page 968

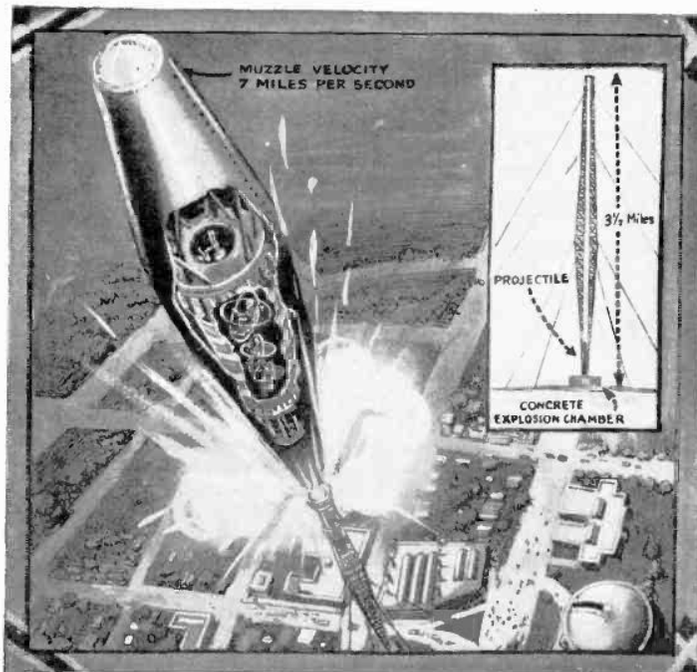
HOWARD V. BROWN

AmericanRadioHistory.Com

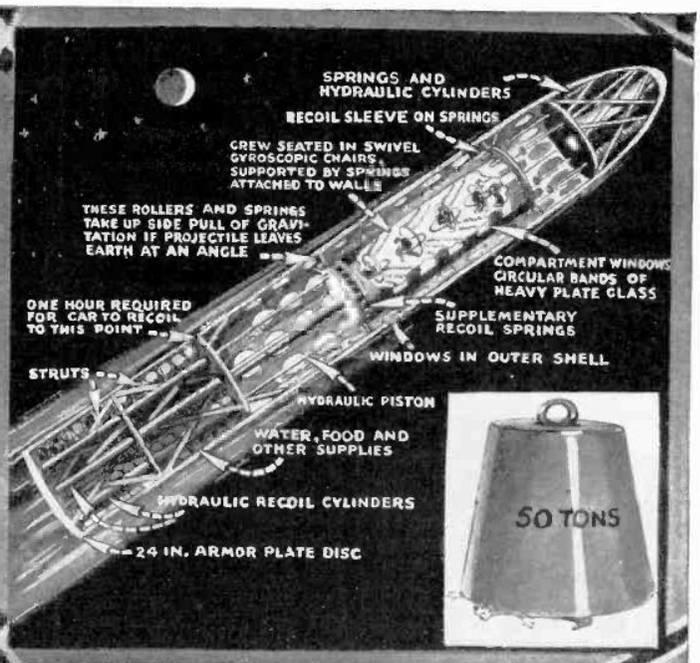
Can We Visit the Planets?

Some of the Problems of Such a Journey.

BY DON HOME.

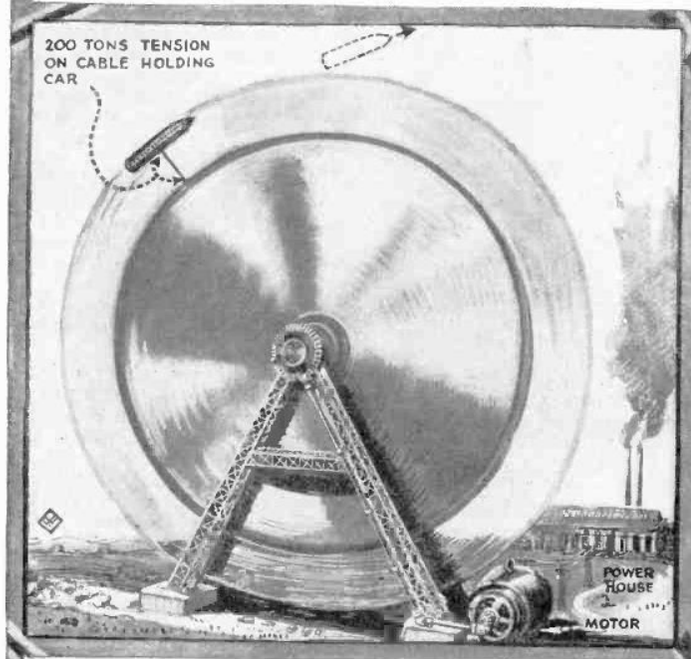


FOR centuries it has been the vision of man to visit other worlds than our own. To do this there is a large number of almost insurmountable problems whose solutions must be found. Not the least of these is a method of obtaining the initial velocity of seven miles per second that must be attained by the projectile which is to carry the man making the visit away against the Earth's power of gravitation, into the realms of space. One of the most obvious devices for gaining such a velocity would be a giant cannon with a barrel 3½ miles long.

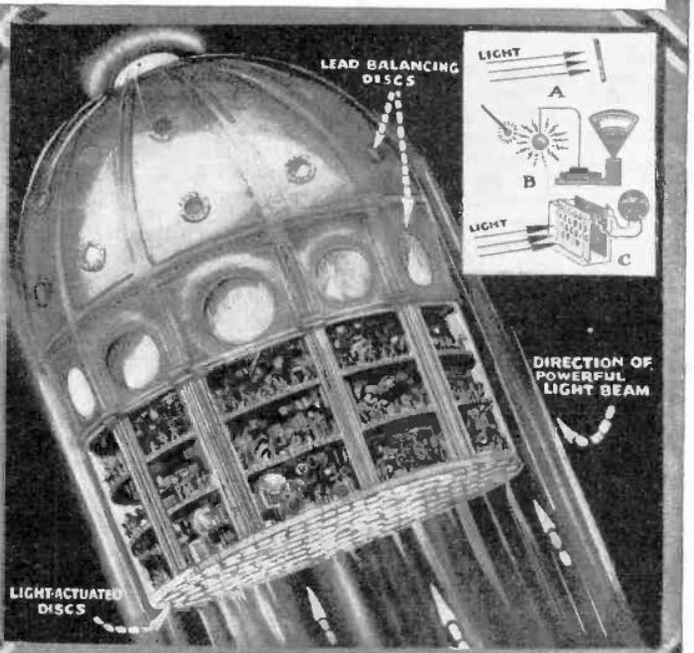


Another grave problem attached to leaving the Earth's surface in any type of vehicle is a means of counteracting the terrific force that the initial velocity would exert on the men in the vehicle. Assuming the initial velocity of seven miles per second, the occupants of the car would be thrown against its walls with a force of more than fifty tons, crushing them into pulp, unless some means of taking up the thrust over a period of an hour could be installed in the car. Above is illustrated one method of absorbing this powerful thrust.

The primary problem of taking up this monstrous thrust might be solved by the hydraulic piston method shown above. Such an arrangement, however, would still leave a considerable power at the end of the operative period of the pistons that would be by no means small. This subsidiary thrust would have to be taken up by another set of springs and pads fixed in the end of the steel cylinder compartment which would serve as the car for the travelers. Each voyager would be fixed, seated, in a gyroscopic swivel chair. The outside framework of the car would be of extra braced steel framework covered with a heavy steel plate. All along the outside walls of the cylinder housing the passengers' cylinder and completely around its circumference there would be glass windows. Near the seat of each of the crew there would also be a window. No matter what position the sliding inside cylinder took the occupants could see out.



Another method suggested for launching an interstellar vehicle into space against the Earth's gravitational pull is illustrated above. A vehicle more or less in the form of a projectile would be lashed to the circumference of a giant fly-wheel and the wheel would be rotated at a circumference speed of a little more than seven miles per second. In such a case some means of protecting the occupants from the crushing power of the centrifugal force would be necessary just as something would be necessary to take up the end thrust in the previous case.



It has been proven that light exerts force on the surface it strikes. (A) Here is a car which would use that force, provided some means of counter-acting gravitation could be found. It has also been noted that by electrification of a lead ball its weight can be lessened, (B), which might be considered ground for the assertion that a means of controlling gravitation will be discovered. Also, light falling on certain bi-metallic cells generates electricity (C), giving another force to move the car.

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(*Continued on page* 1050)

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Radio Town Crier

By H. Gernsback.

THE accompanying illustration shows a gigantic radio loud-speaker which probably will be known in the future as the Municipal Announcer. Experiments made for the past few years have shown that it is possible to so amplify the human voice, by means of huge horns and vacuum tubes, that it will be heard over a radius of from three to five miles so that each and every word will be understood clearly. In our Electrical Experimenter of November, 1919 issue, there was illustrated how huge horns placed in a church tower projected sound four to five miles.

The idea of the Municipal Loud Speaker is as follows: Huge sky-scrapers, as shown in the illustration, would be equipped with a number of concrete or non-vibrating metallic horns, pointing downward as shown. In this position, the sounds will be dispersed towards the street and buildings, and will also prevent rain and snow entering the horn itself. In cities like New York and Chicago, such horns would be erected every one or two miles. It goes without saying that present buildings can be equipped with such horns, but in the future probably a new sort of architecture will be evolved to take care of them.

The purpose of these Municipal Announcers will be simple. Any news, either of civic or national importance, can be broadcast so that the whole city can hear every word. By opening your office or home window, it will be possible to listen to every word spoken. Thus a Presidential speech, a talk by the Mayor of the city, or any other important feature can be **instantly** transmitted to the entire populace.

For police work, such a device will be of tremendous importance. Suppose a robbery or a murder is committed; the police headquarters can immediately broadcast this news so that every citizen in the neighborhood will be on the look-out for a certain car and will have a description of the law-breaker. The important part is that the information will be instantaneous, which in the detection of crime, is of utmost importance.

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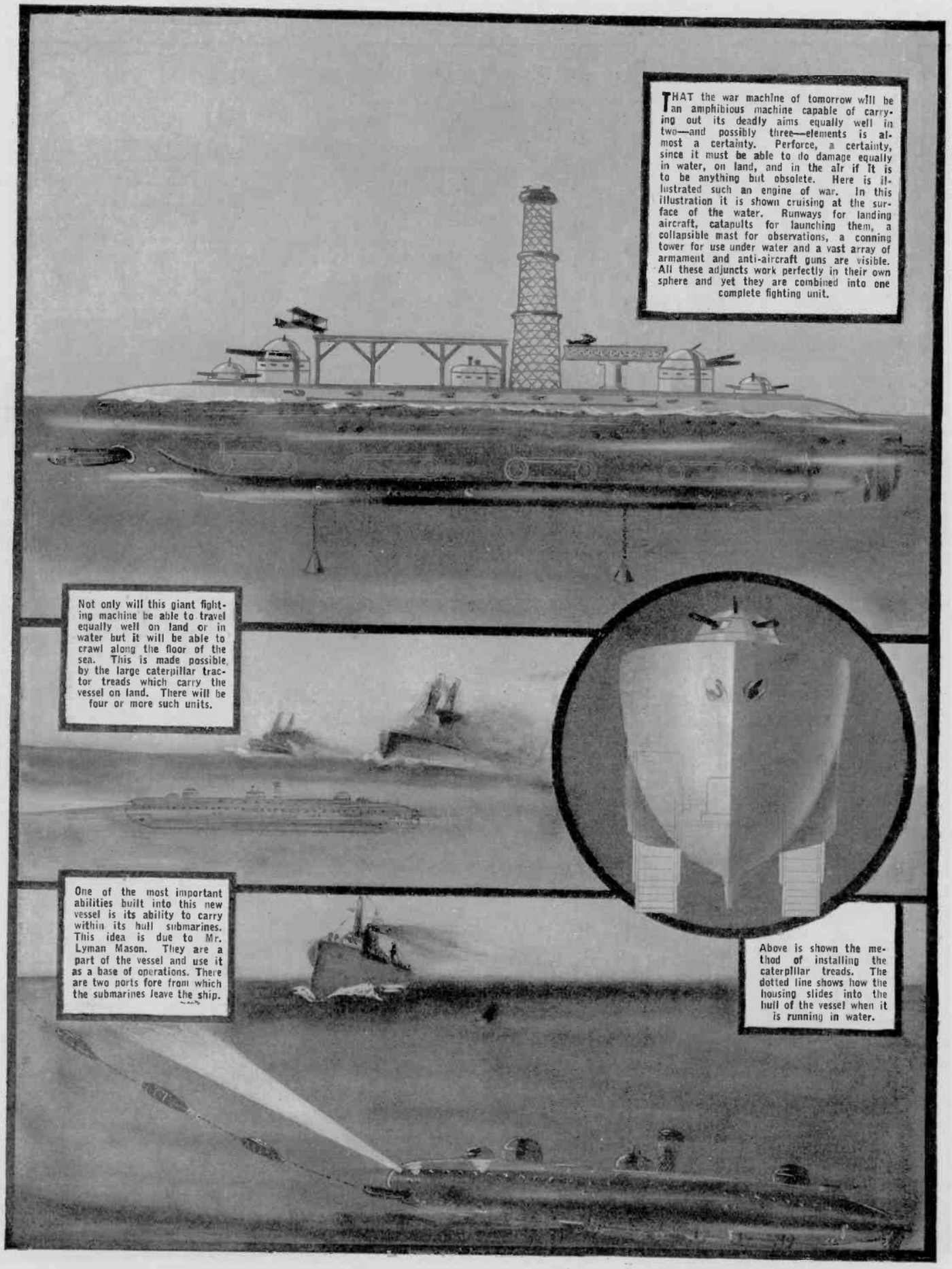
The War Machine of Tomorrow



THAT the war machine of tomorrow will be an amphibious machine capable of carrying out its deadly aims equally well in two—and possibly three—elements is almost a certainty. Perforce, a certainty, since it must be able to do damage equally in water, on land, and in the air if it is to be anything but obsolete. Here is illustrated such an engine of war. In this illustration it is shown cruising at the surface of the water. Runways for landing aircraft, catapults for launching them, a collapsible mast for observations, a conning tower for use under water and a vast array of armament and anti-aircraft guns are visible. All these adjuncts work perfectly in their own sphere and yet they are combined into one complete fighting unit.

Not only will this giant fighting machine be able to travel equally well on land or in water but it will be able to crawl along the floor of the sea. This is made possible by the large caterpillar tractor treads which carry the vessel on land. There will be four or more such units.

One of the most important abilities built into this new vessel is its ability to carry within its hull submarines. This idea is due to Mr. Lyman Mason. They are a part of the vessel and use it as a base of operations. There are two ports fore from which the submarines leave the ship.

Above is shown the method of installing the caterpillar treads. The dotted line shows how the housing slides into the hull of the vessel when it is running in water.

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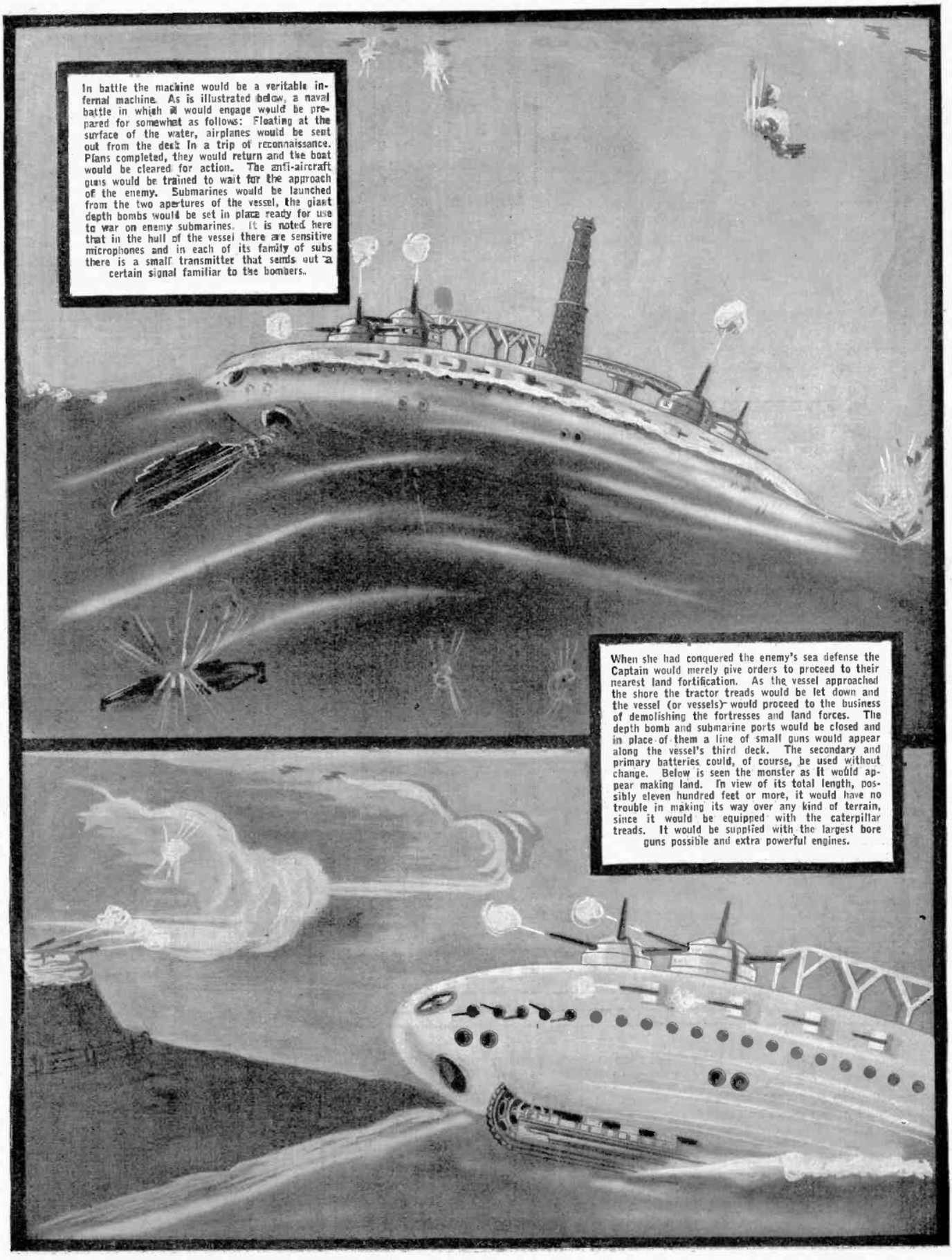
An Amphibian Beast of Prey



In battle the machine would be a veritable infernal machine. As is illustrated below, a naval battle in which it would engage would be prepared for somewhat as follows: Floating at the surface of the water, airplanes would be sent out from the deck in a trip of reconnaissance. Plans completed, they would return and the boat would be cleared for action. The anti-aircraft guns would be trained to wait for the approach of the enemy. Submarines would be launched from the two apertures of the vessel, the giant depth bombs would be set in place ready for use to war on enemy submarines. It is noted here that in the hull of the vessel there are sensitive microphones and in each of its family of subs there is a small transmitter that sends out a certain signal familiar to the bombers.

When she had conquered the enemy's sea defense the Captain would merely give orders to proceed to their nearest land fortification. As the vessel approached the shore the tractor treads would be let down and the vessel (or vessels) would proceed to the business of demolishing the fortresses and land forces. The depth bomb and submarine ports would be closed and in place of them a line of small guns would appear along the vessel's third deck. The secondary and primary batteries could, of course, be used without change. Below is seen the monster as it would appear making land. In view of its total length, possibly eleven hundred feet or more, it would have no trouble in making its way over any kind of terrain, since it would be equipped with the caterpillar treads. It would be supplied with the largest bore guns possible and extra powerful engines.

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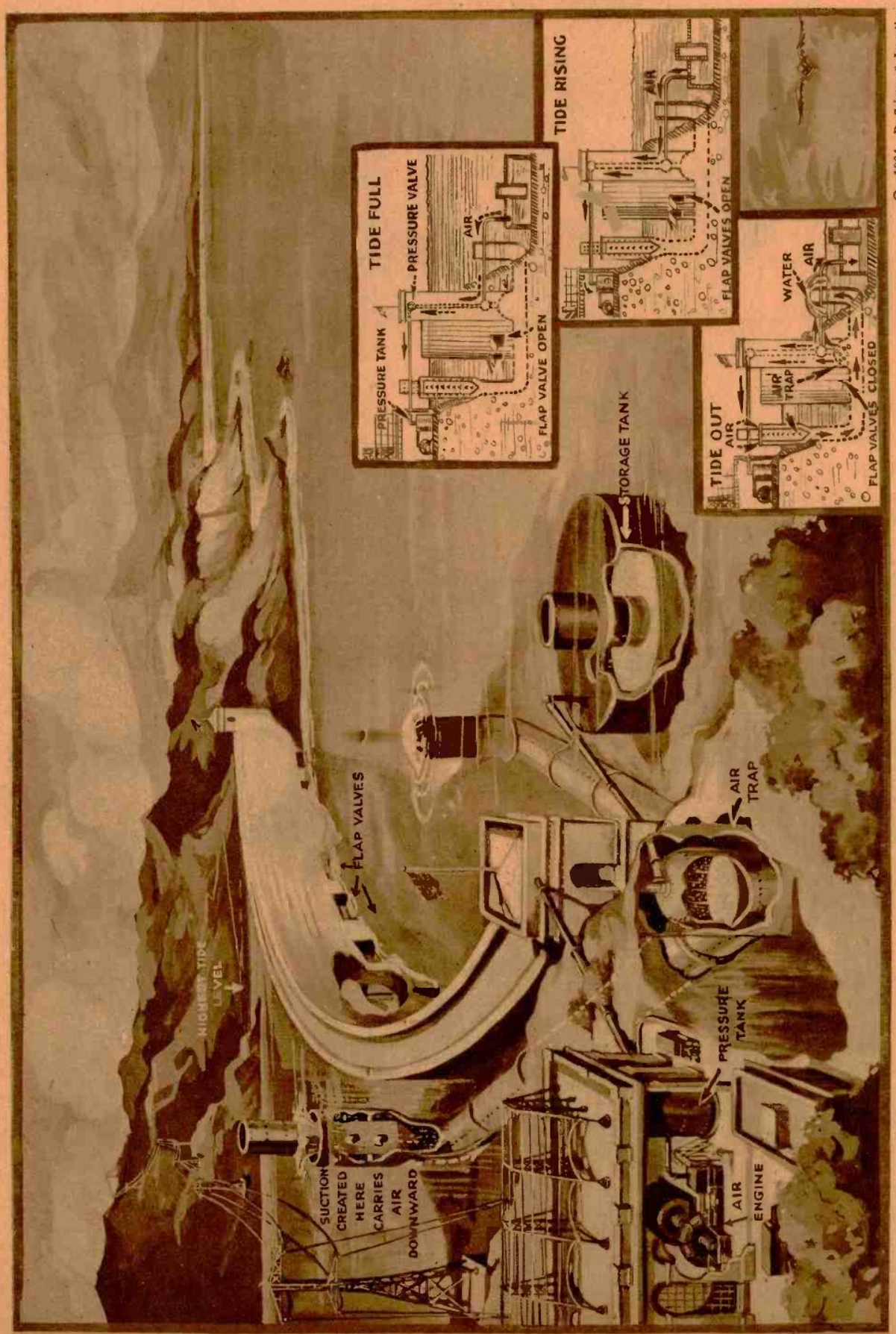
Tides to Develop Power

Making Tides Act as Air Compressors and Using the Power So Developed.

BY JOSEPH H. KRAUS



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The inventor of this system of producing power from the tides, John S. Leger McGinn, intends to build a wall with crest rising above the highest tide across a natural basin. The wall has openings with hinged gates or flap-valves to allow the water to pass into the basin when the tide is rising, but which will close when the tide falls, preventing the water from leaving the basin. Within the basin a pipe will be built which will pass through the wall to the sea, through which pipe the water as it escapes will flow in. In doing so the water will carry a great quantity of air with it, which is caught in an air trap. This air, under the pressure it has attained, will then be used to drive the air engines and generators. The question arises, "what happens when the tide is rising or full?" This is answered in the small illustrations. When the tide is full, it is obvious that no power will be developed by the system, because no water is flowing from the basin into the sea. However, there is a storage tank from which the air passes to the generating station. The small tube in the center of the reservoir allows water to pass downward into the storage tank and forces the air out at the top.

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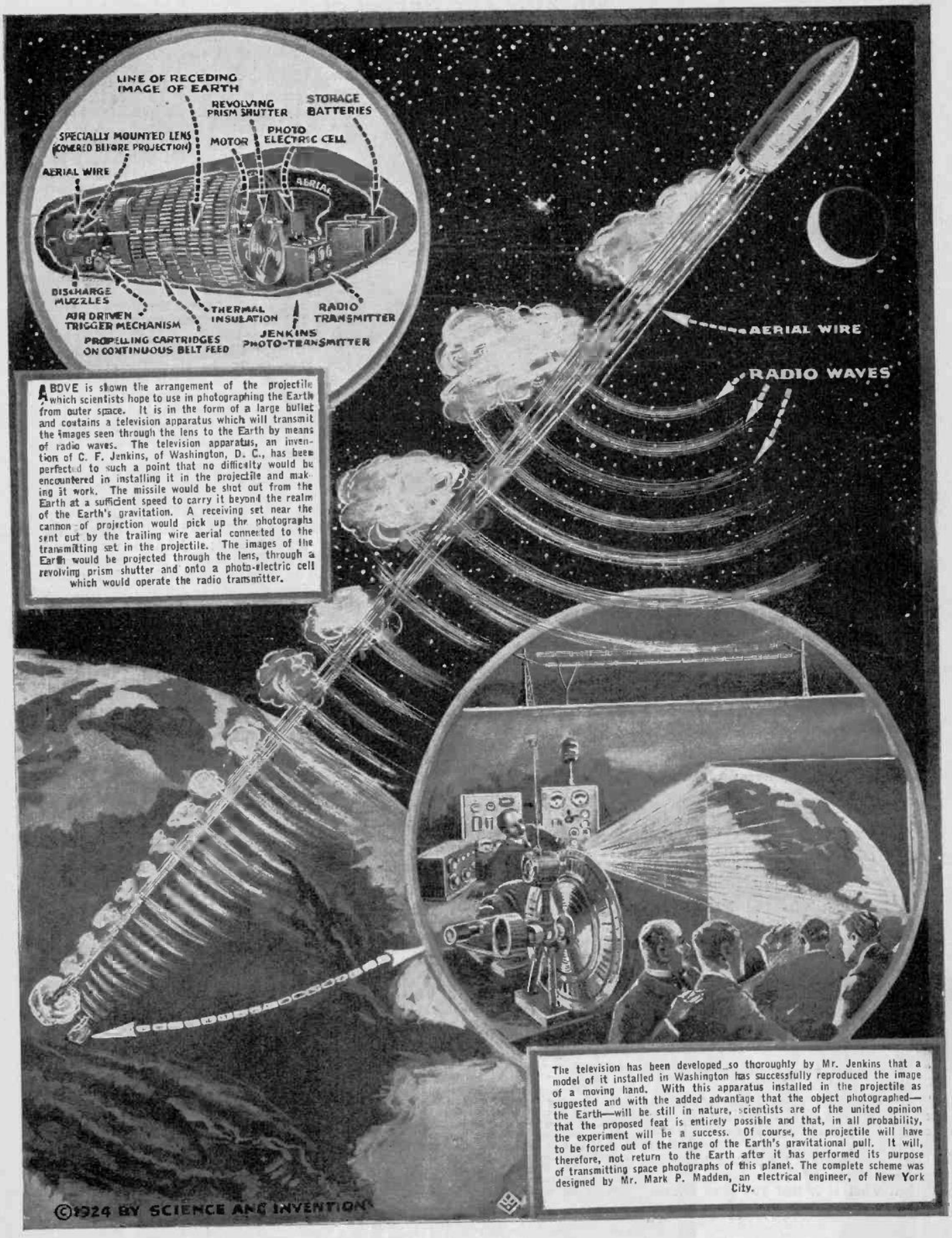
Picture of the Earth

Radio Television to Photograph Earth from Space.

BY RAYMOND FRANCIS YATES



ABOVE is shown the arrangement of the projectile which scientists hope to use in photographing the Earth from outer space. It is in the form of a large bullet and contains a television apparatus which will transmit the images seen through the lens to the Earth by means of radio waves. The television apparatus, an invention of C. F. Jenkins, of Washington, D. C., has been perfected to such a point that no difficulty would be encountered in installing it in the projectile and making it work. The missile would be shot out from the Earth at a sufficient speed to carry it beyond the realm of the Earth's gravitation. A receiving set near the cannon of projection would pick up the photographs sent out by the trailing wire aerial connected to the transmitting set in the projectile. The images of the Earth would be projected through the lens, through a revolving prism shutter and onto a photo-electric cell which would operate the radio transmitter.

The television has been developed so thoroughly by Mr. Jenkins that a model of it installed in Washington has successfully reproduced the image of a moving hand. With this apparatus installed in the projectile as suggested and with the added advantage that the object photographed—the Earth—will be still in nature, scientists are of the united opinion that the proposed feat is entirely possible and that, in all probability, the experiment will be a success. Of course, the projectile will have to be forced out of the range of the Earth's gravitational pull. It will, therefore, not return to the Earth after it has performed its purpose of transmitting space photographs of this planet. The complete scheme was designed by Mr. Mark P. Madden, an electrical engineer, of New York City.

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March

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THE NEW Science and Invention

IN PICTURES

SPEAKING TO MARS OVER A LIGHT BEAM

See Page 1086

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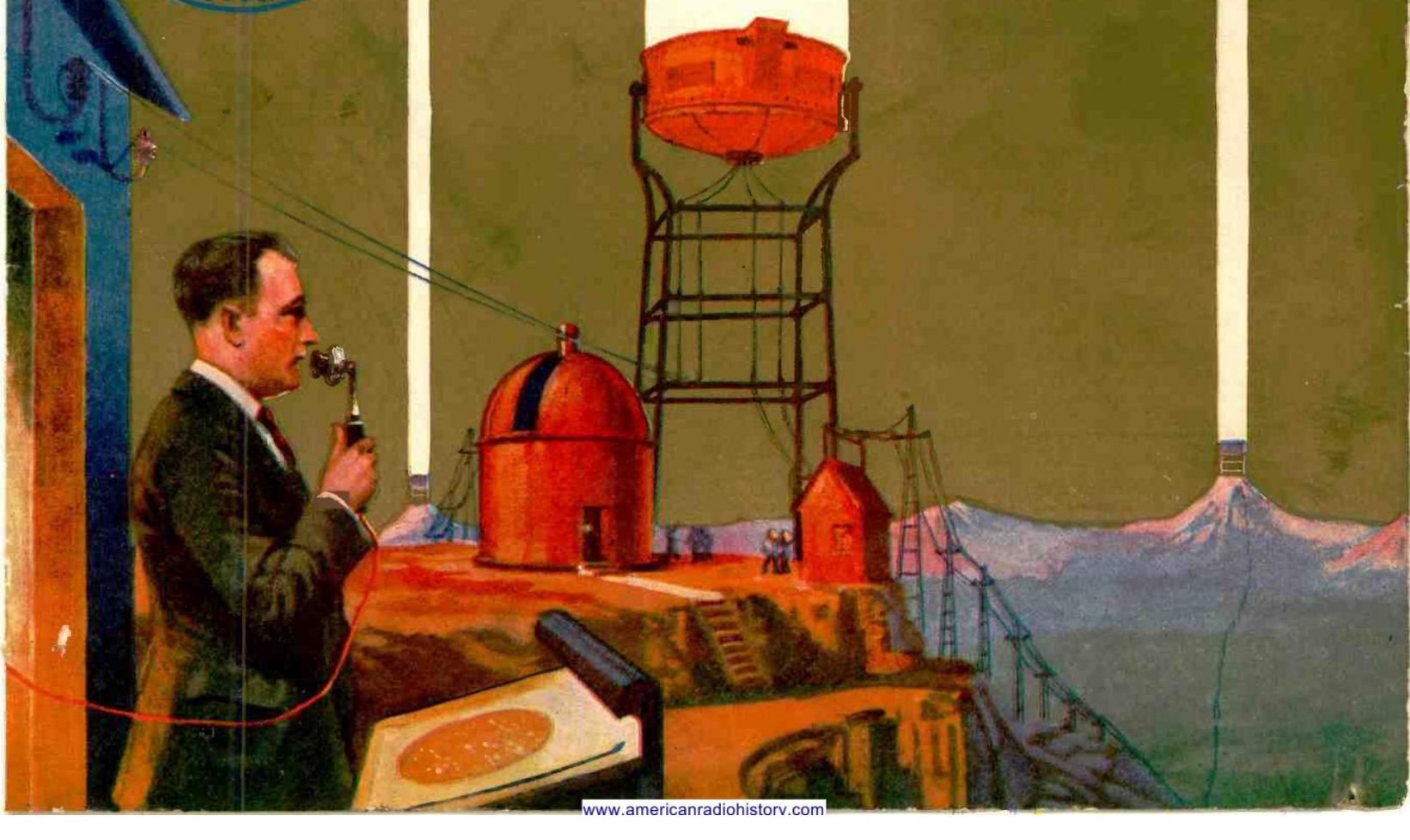
See Page 1088



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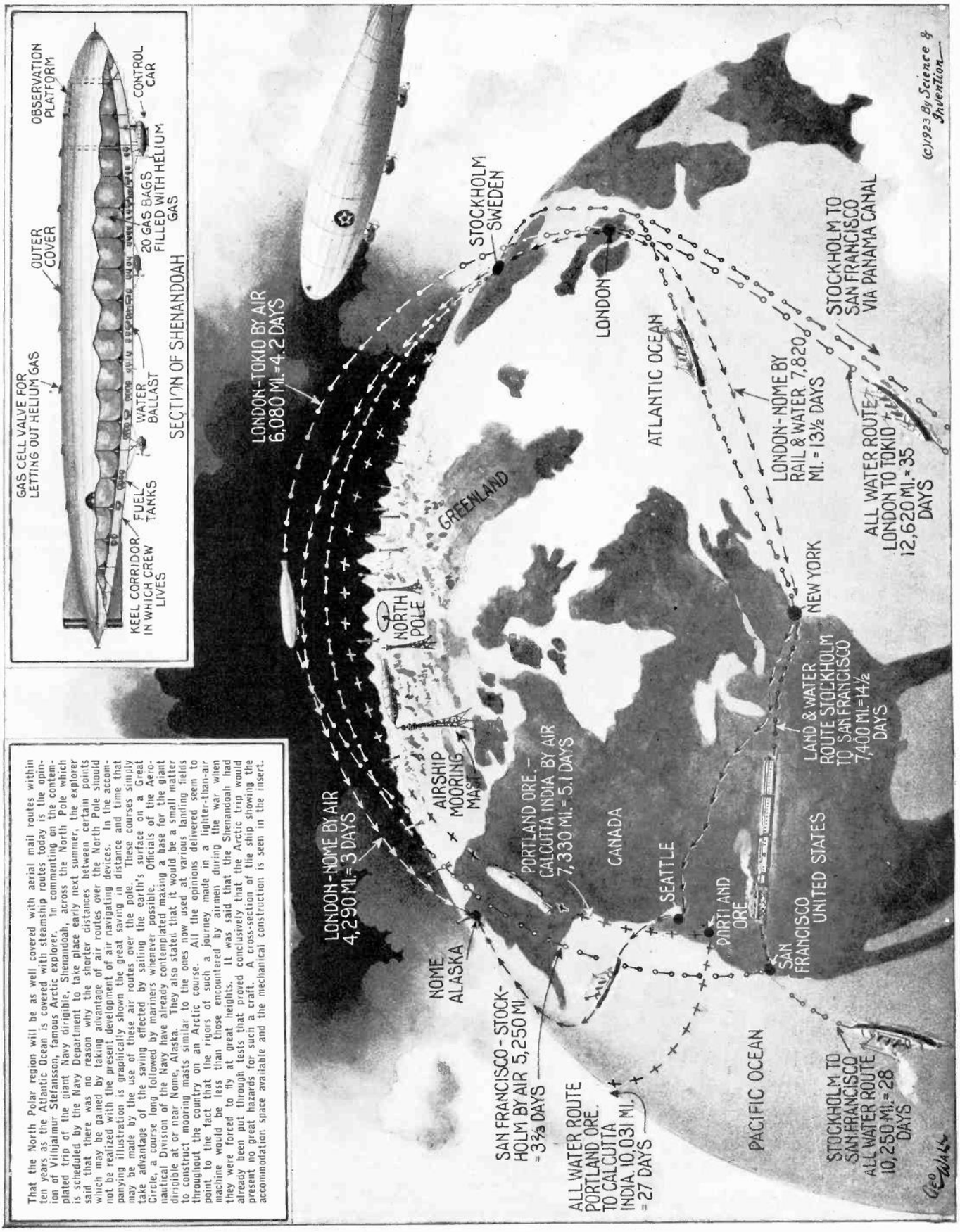
Trans-Polar Mail Routes Soon

Arctic Explorer Stefansson Predicts New Air Routes Across Pole.

By H. WINFIELD SECOR



That the North Polar region will be as well covered with aerial mail routes within ten years as the Atlantic Ocean is covered with steamship routes today is the opinion of Vilhjalmur Stefansson, famous Arctic explorer. In commenting on the contemplated trip of the giant Navy dirigible, Shenandoah, across the North Pole which is scheduled by the Navy Department to take place early next summer, the explorer said that there was no reason why the shorter distances between certain points which may be gained by taking advantage of air routes over the North Pole should not be realized with the present development of air navigating devices. In the accompanying illustration is graphically shown the great saving in distance and time that may be made by the use of these air routes over the pole. These courses simply take advantage of the saving effected by sailing the earth's surface on a Great Circle, a course long followed by mariners whenever possible. Officials of the Aeronautical Division of the Navy have already contemplated making a base for the giant dirigible at or near Nome, Alaska. They also stated that it would be a small matter to construct mooring masts similar to the ones now used at various landing fields throughout the country on an Arctic course. All the opinions delivered seem to point to the fact that the rigors of such a journey made in a lighter-than-air machine would be less than those encountered by airmen during the war when they were forced to fly at great heights. It was said that the Shenandoah had already been put through tests that proved conclusively that the Arctic trip would present no great hazards for such a craft. A cross-section of the ship showing the accommodation space available and the mechanical construction is seen in the insert.

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How I Would Speak to Mars

By H. GERNSBACK
MEMBER AMERICAN PHYSICAL SOCIETY

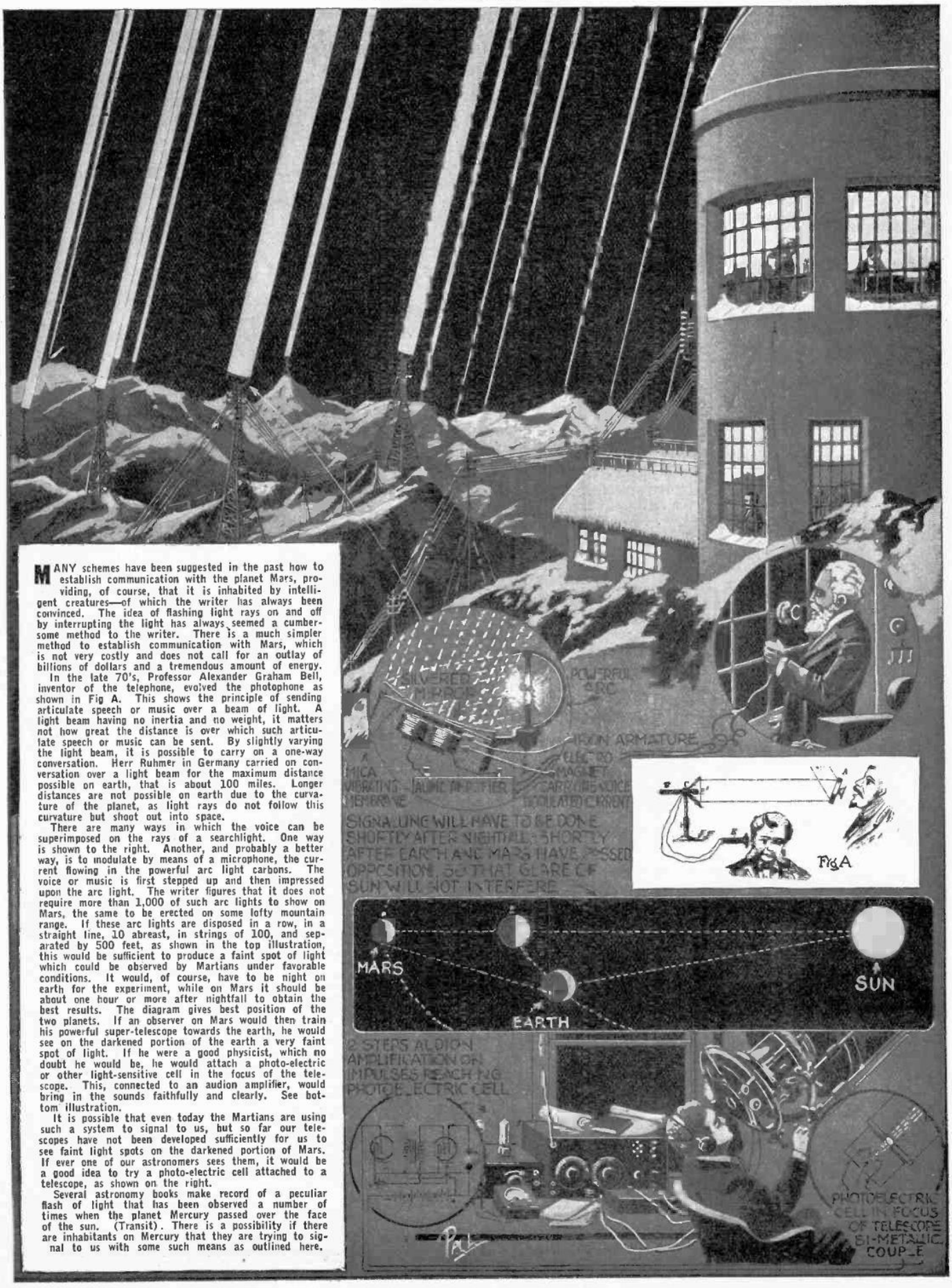
MANY schemes have been suggested in the past how to establish communication with the planet Mars, providing, of course, that it is inhabited by intelligent creatures—of which the writer has always been convinced. The idea of flashing light rays on and off by interrupting the light has always seemed a cumbersome method to the writer. There is a much simpler method to establish communication with Mars, which is not very costly and does not call for an outlay of billions of dollars and a tremendous amount of energy.

In the late 70's, Professor Alexander Graham Bell, inventor of the telephone, evolved the photophone as shown in Fig A. This shows the principle of sending articulate speech or music over a beam of light. A light beam having no inertia and no weight, it matters not how great the distance is over which such articulate speech or music can be sent. By slightly varying the light beam, it is possible to carry on a one-way conversation. Herr Ruhmer in Germany carried on conversation over a light beam for the maximum distance possible on earth, that is about 100 miles. Longer distances are not possible on earth due to the curvature of the planet, as light rays do not follow this curvature but shoot out into space.

There are many ways in which the voice can be superimposed on the rays of a searchlight. One way is shown to the right. Another, and probably a better way, is to modulate by means of a microphone, the current flowing in the powerful arc light carbons. The voice or music is first stepped up and then impressed upon the arc light. The writer figures that it does not require more than 1,000 of such arc lights to show on Mars, the same to be erected on some lofty mountain range. If these arc lights are disposed in a row, in a straight line, 10 abreast, in strings of 100, and separated by 500 feet, as shown in the top illustration, this would be sufficient to produce a faint spot of light which could be observed by Martians under favorable conditions. It would, of course, have to be night on earth for the experiment, while on Mars it should be about one hour or more after nightfall to obtain the best results. The diagram gives best position of the two planets. If an observer on Mars would then train his powerful super-telescope towards the earth, he would see on the darkened portion of the earth a very faint spot of light. If he were a good physicist, which no doubt he would be, he would attach a photo-electric or other light-sensitive cell in the focus of the telescope. This, connected to an audion amplifier, would bring in the sounds faithfully and clearly. See bottom illustration.

It is possible that even today the Martians are using such a system to signal to us, but so far our telescopes have not been developed sufficiently for us to see faint light spots on the darkened portion of Mars. If ever one of our astronomers sees them, it would be a good idea to try a photo-electric cell attached to a telescope, as shown on the right.

Several astronomy books make record of a peculiar flash of light that has been observed a number of times when the planet Mercury passed over the face of the sun. (Transit). There is a possibility if there are inhabitants on Mercury that they are trying to signal to us with some such means as outlined here.



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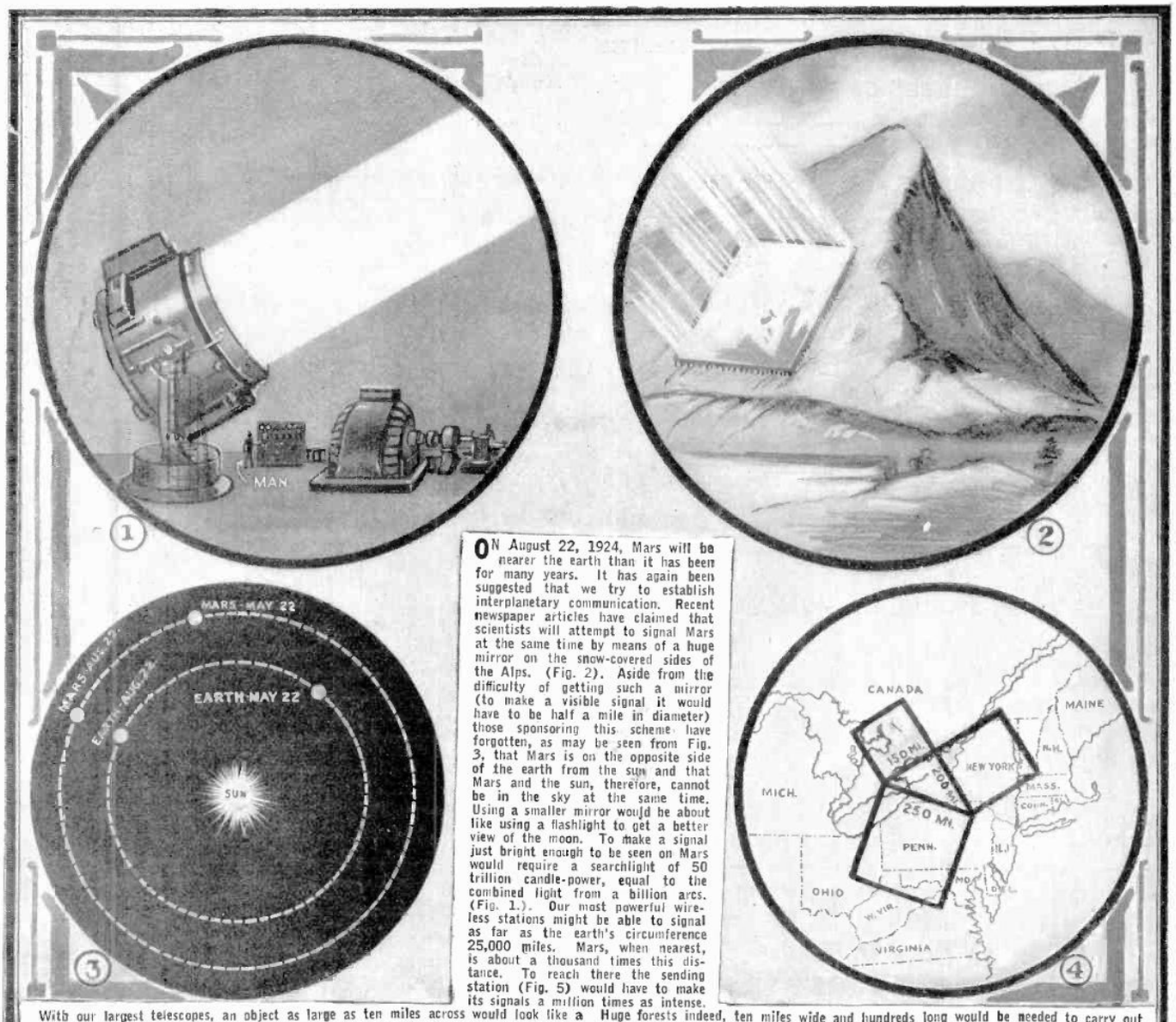
Can We Signal Mars?

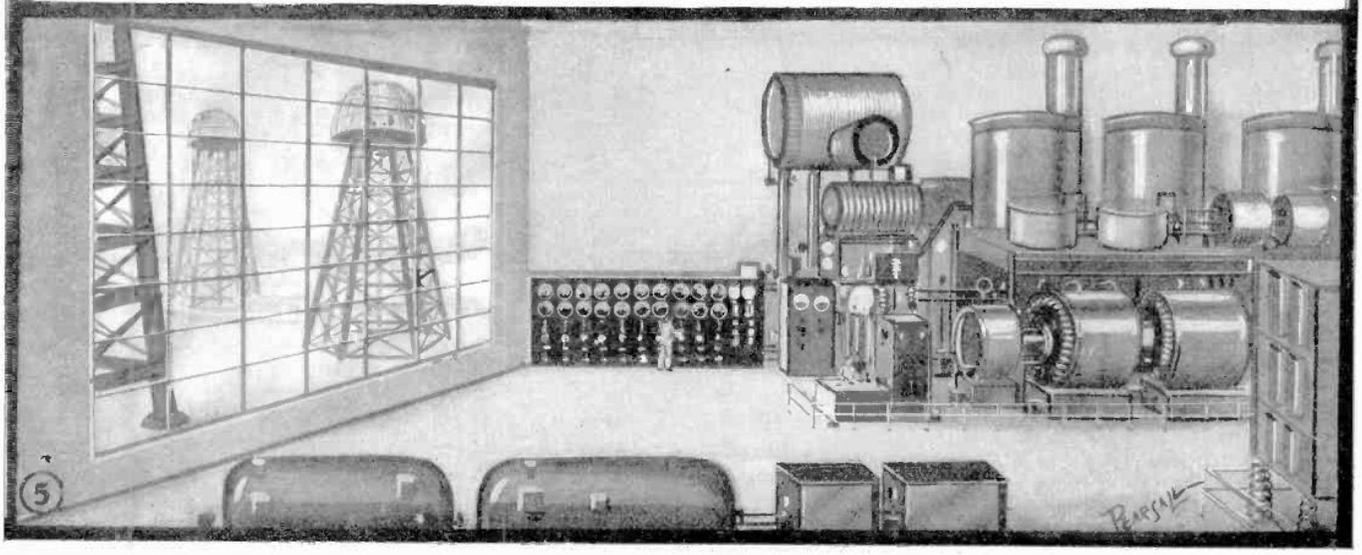
Coming Opposition Raises Question

BY CHARLES T. DAHAMA



ON August 22, 1924, Mars will be nearer the earth than it has been for many years. It has again been suggested that we try to establish interplanetary communication. Recent newspaper articles have claimed that scientists will attempt to signal Mars at the same time by means of a huge mirror on the snow-covered sides of the Alps. (Fig. 2). Aside from the difficulty of getting such a mirror (to make a visible signal it would have to be half a mile in diameter) those sponsoring this scheme have forgotten, as may be seen from Fig. 3, that Mars is on the opposite side of the earth from the sun and that Mars and the sun, therefore, cannot be in the sky at the same time. Using a smaller mirror would be about like using a flashlight to get a better view of the moon. To make a signal just bright enough to be seen on Mars would require a searchlight of 50 trillion candle-power, equal to the combined light from a billion arcs. (Fig. 1.). Our most powerful wireless stations might be able to signal as far as the earth's circumference 25,000 miles. Mars, when nearest, is about a thousand times this distance. To reach there the sending station (Fig. 5) would have to make its signals a million times as intense. Huge forests indeed, ten miles wide and hundreds long would be needed to carry out this idea. It is the author's hope that these statistics will settle definitely the perennial question of signalling Mars.

With our largest telescopes, an object as large as ten miles across would look like a mere speck. It has been suggested that we plant trees in huge geometrical figures (Fig. 4) so that our Martian brothers may see that intelligent life exists here.



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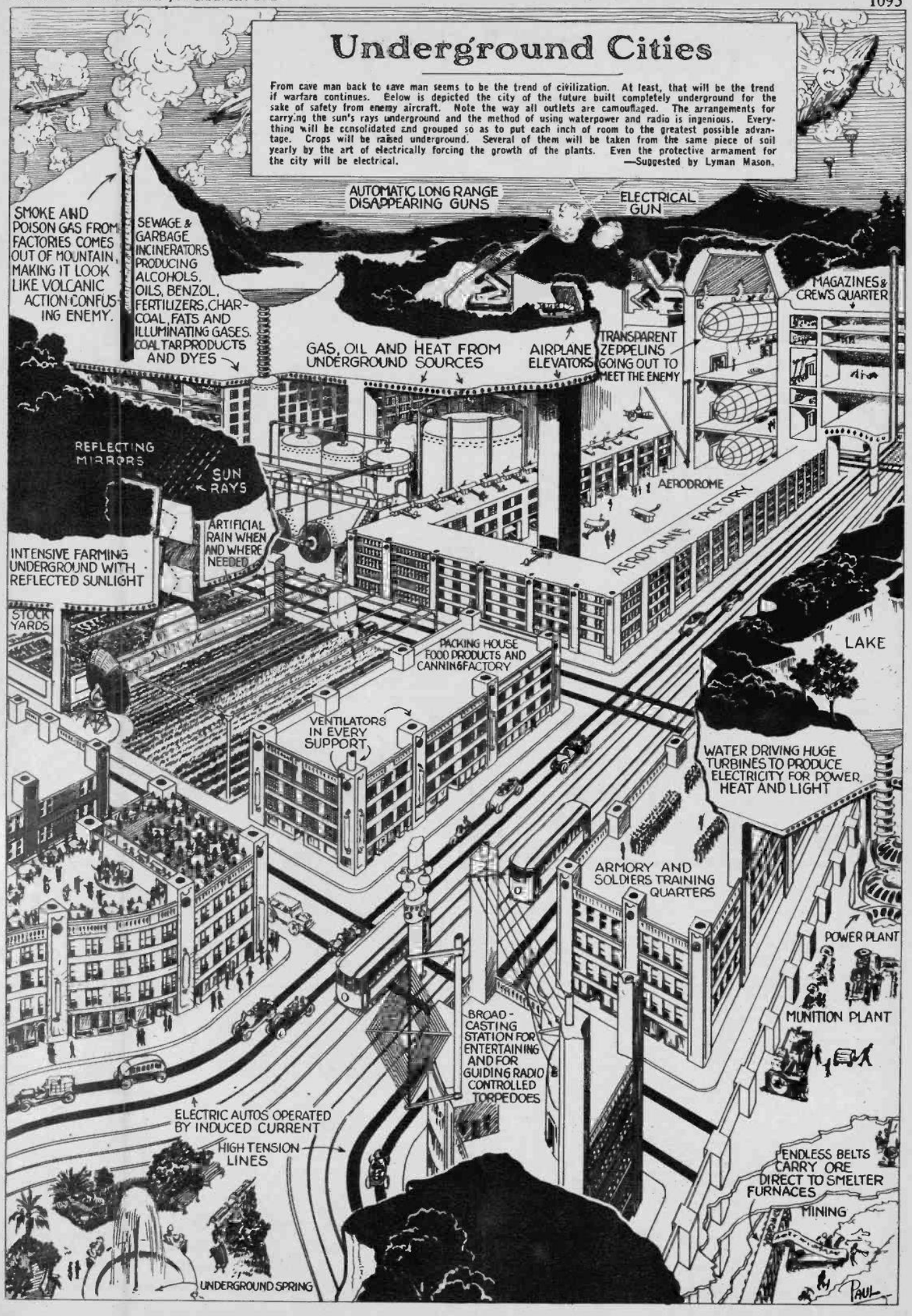
Underground Cities

From cave man back to cave man seems to be the trend of civilization. At least, that will be the trend if warfare continues. Below is depicted the city of the future built completely underground for the sake of safety from enemy aircraft. Note the way all outlets are camouflaged. The arrangements for carrying the sun's rays underground and the method of using waterpower and radio is ingenious. Everything will be consolidated and grouped so as to put each inch of room to the greatest possible advantage. Crops will be raised underground. Several of them will be taken from the same piece of soil yearly by the art of electrically forcing the growth of the plants. Even the protective armament for the city will be electrical.

—Suggested by Lyman Mason.



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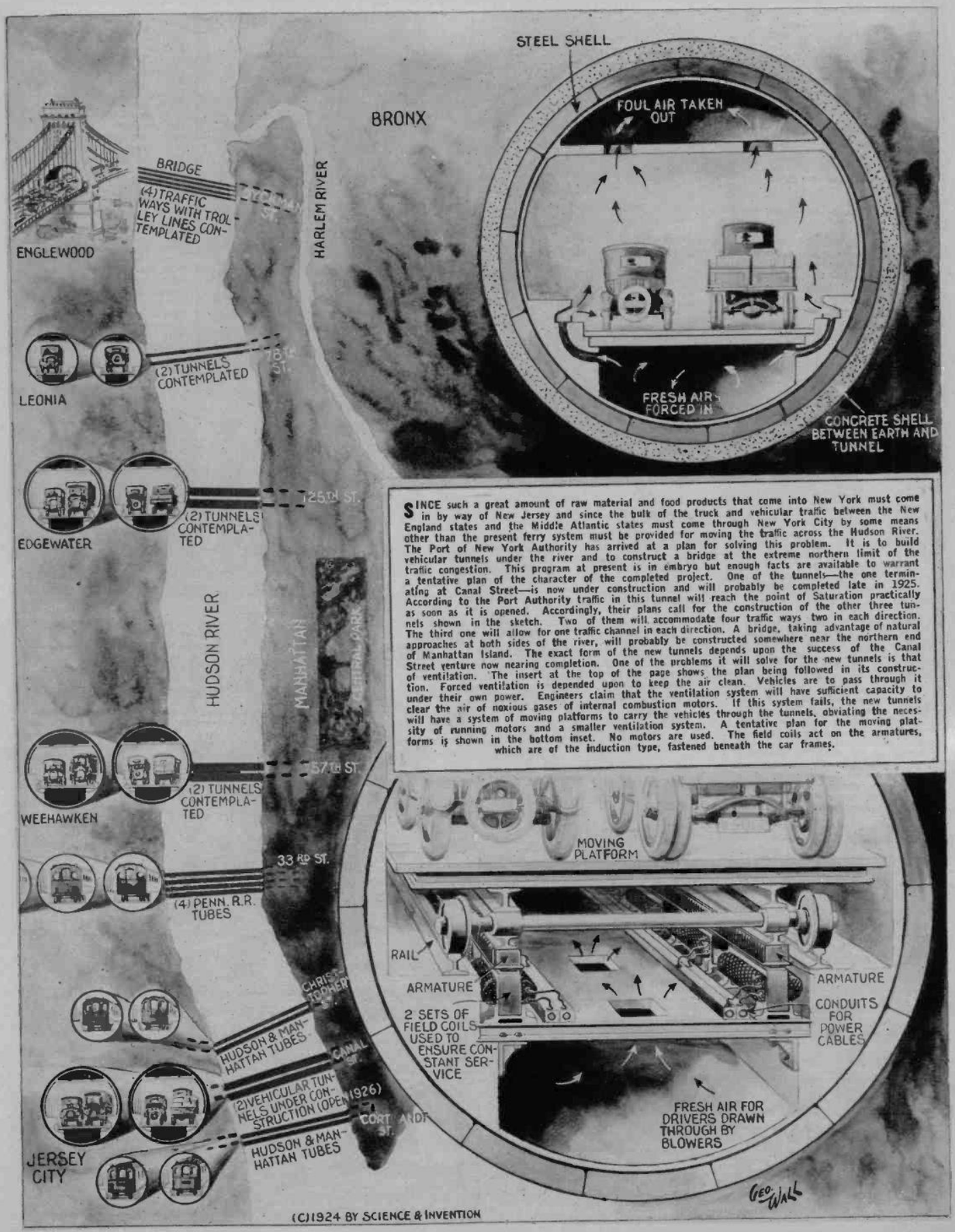
Eight Tunnels Under the Hudson

Vehicular Tunnels Under Hudson River Proposed to Relieve Traffic.

By W. B. ARVIN.



SINCE such a great amount of raw material and food products that come into New York must come in by way of New Jersey and since the bulk of the truck and vehicular traffic between the New England states and the Middle Atlantic states must come through New York City by some means other than the present ferry system must be provided for moving the traffic across the Hudson River. The Port of New York Authority has arrived at a plan for solving this problem. It is to build vehicular tunnels under the river and to construct a bridge at the extreme northern limit of the traffic congestion. This program at present is in embryo but enough facts are available to warrant a tentative plan of the character of the completed project. One of the tunnels—the one terminating at Canal Street—is now under construction and will probably be completed late in 1925. According to the Port Authority traffic in this tunnel will reach the point of Saturation practically as soon as it is opened. Accordingly, their plans call for the construction of the other three tunnels shown in the sketch. Two of them will accommodate four traffic ways two in each direction. The third one will allow for one traffic channel in each direction. A bridge, taking advantage of natural approaches at both sides of the river, will probably be constructed somewhere near the northern end of Manhattan Island. The exact form of the new tunnels depends upon the success of the Canal Street venture now nearing completion. One of the problems it will solve for the new tunnels is that of ventilation. The insert at the top of the page shows the plan being followed in its construction. Forced ventilation is depended upon to keep the air clean. Vehicles are to pass through it under their own power. Engineers claim that the ventilation system will have sufficient capacity to clear the air of noxious gases of internal combustion motors. If this system fails, the new tunnels will have a system of moving platforms to carry the vehicles through the tunnels, obviating the necessity of running motors and a smaller ventilation system. A tentative plan for the moving platforms is shown in the bottom inset. No motors are used. The field coils act on the armatures, which are of the induction type, fastened beneath the car frames.

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May

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Science and Invention

IN PICTURES

The RADIO POLICE AUTOMATON

See Page 14

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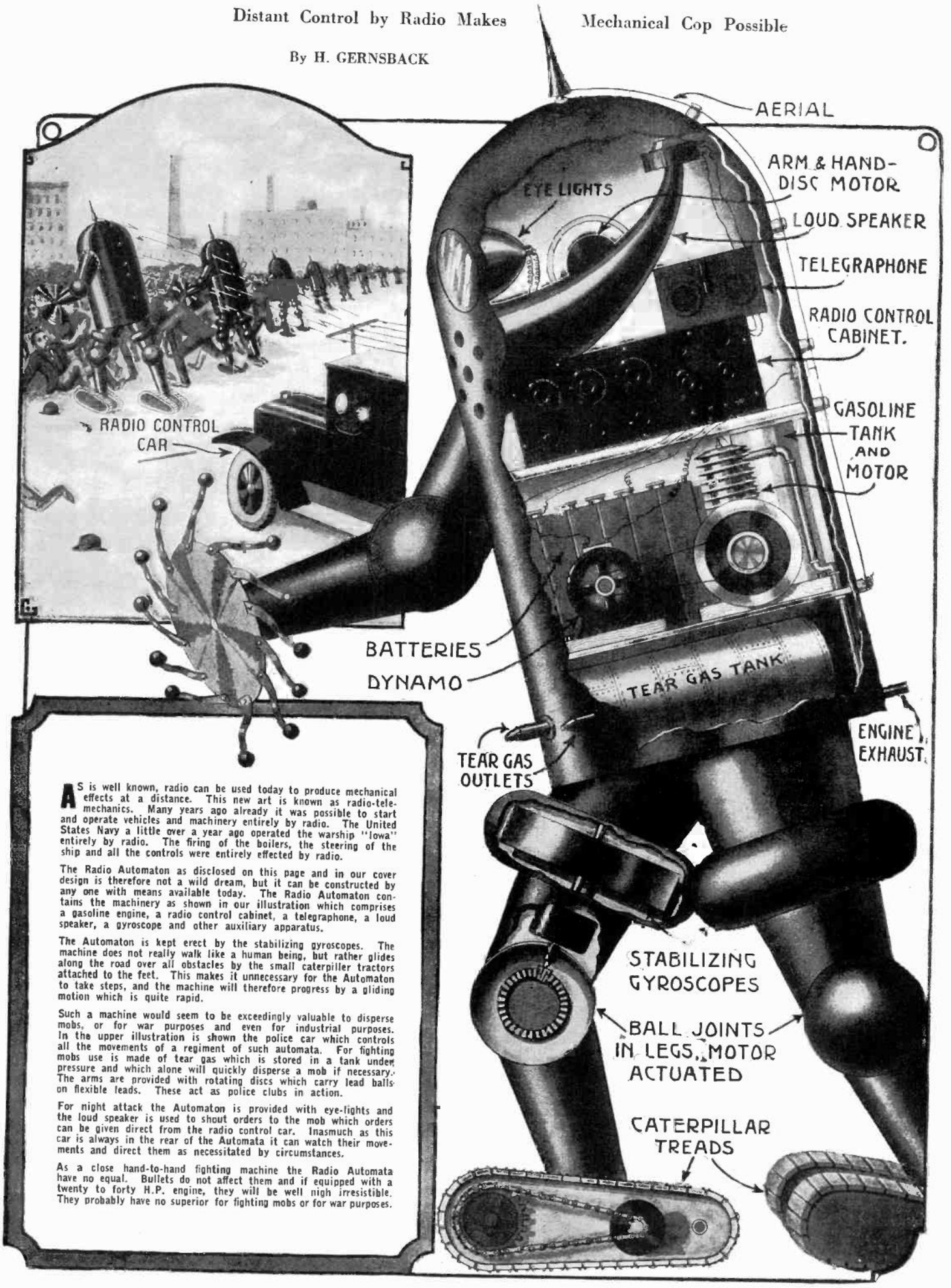
See Page 60

Radio Police Automaton

Distant Control by Radio Makes Mechanical Cop Possible

By H. GERNSBACK



AS is well known, radio can be used today to produce mechanical effects at a distance. This new art is known as radio-telemechanics. Many years ago already it was possible to start and operate vehicles and machinery entirely by radio. The United States Navy a little over a year ago operated the warship "Iowa" entirely by radio. The firing of the boilers, the steering of the ship and all the controls were entirely effected by radio.

The Radio Automaton as disclosed on this page and in our cover design is therefore not a wild dream, but it can be constructed by any one with means available today. The Radio Automaton contains the machinery as shown in our illustration which comprises a gasoline engine, a radio control cabinet, a telegraphone, a loud speaker, a gyroscope and other auxiliary apparatus.

The Automaton is kept erect by the stabilizing gyroscopes. The machine does not really walk like a human being, but rather glides along the road over all obstacles by the small caterpiller tractors attached to the feet. This makes it unnecessary for the Automaton to take steps, and the machine will therefore progress by a gliding motion which is quite rapid.

Such a machine would seem to be exceedingly valuable to disperse mobs, or for war purposes and even for industrial purposes. In the upper illustration is shown the police car which controls all the movements of a regiment of such automata. For fighting mobs use is made of tear gas which is stored in a tank under pressure and which alone will quickly disperse a mob if necessary. The arms are provided with rotating discs which carry lead balls on flexible leads. These act as police clubs in action.

For night attack the Automaton is provided with eye-lights and the loud speaker is used to shout orders to the mob which orders can be given direct from the radio control car. Inasmuch as this car is always in the rear of the Automata it can watch their movements and direct them as necessitated by circumstances.

As a close hand-to-hand fighting machine the Radio Automata have no equal. Bullets do not affect them and if equipped with a twenty to forty H.P. engine, they will be well nigh irresistible. They probably have no superior for fighting mobs or for war purposes.

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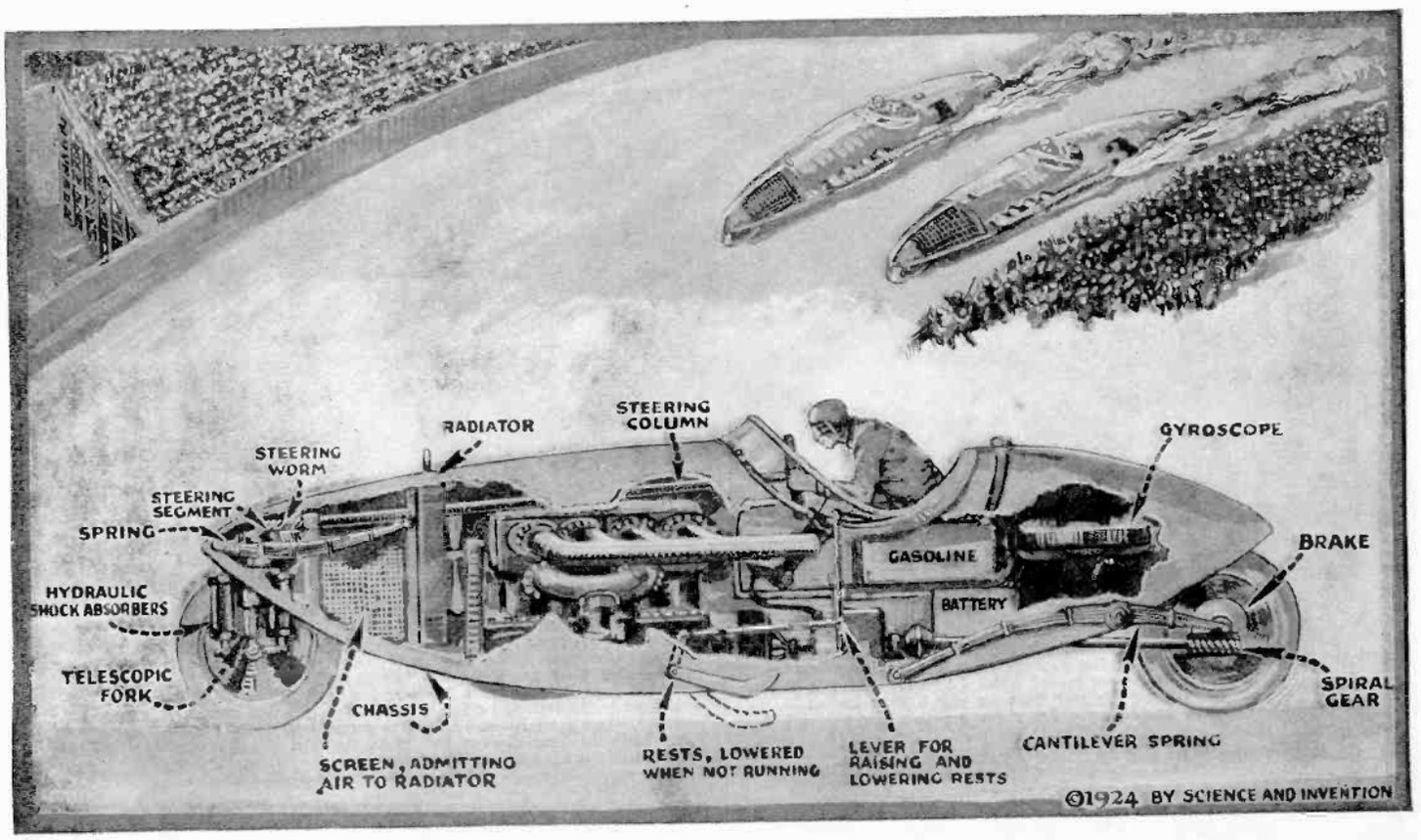
Gyroscope Racing Car

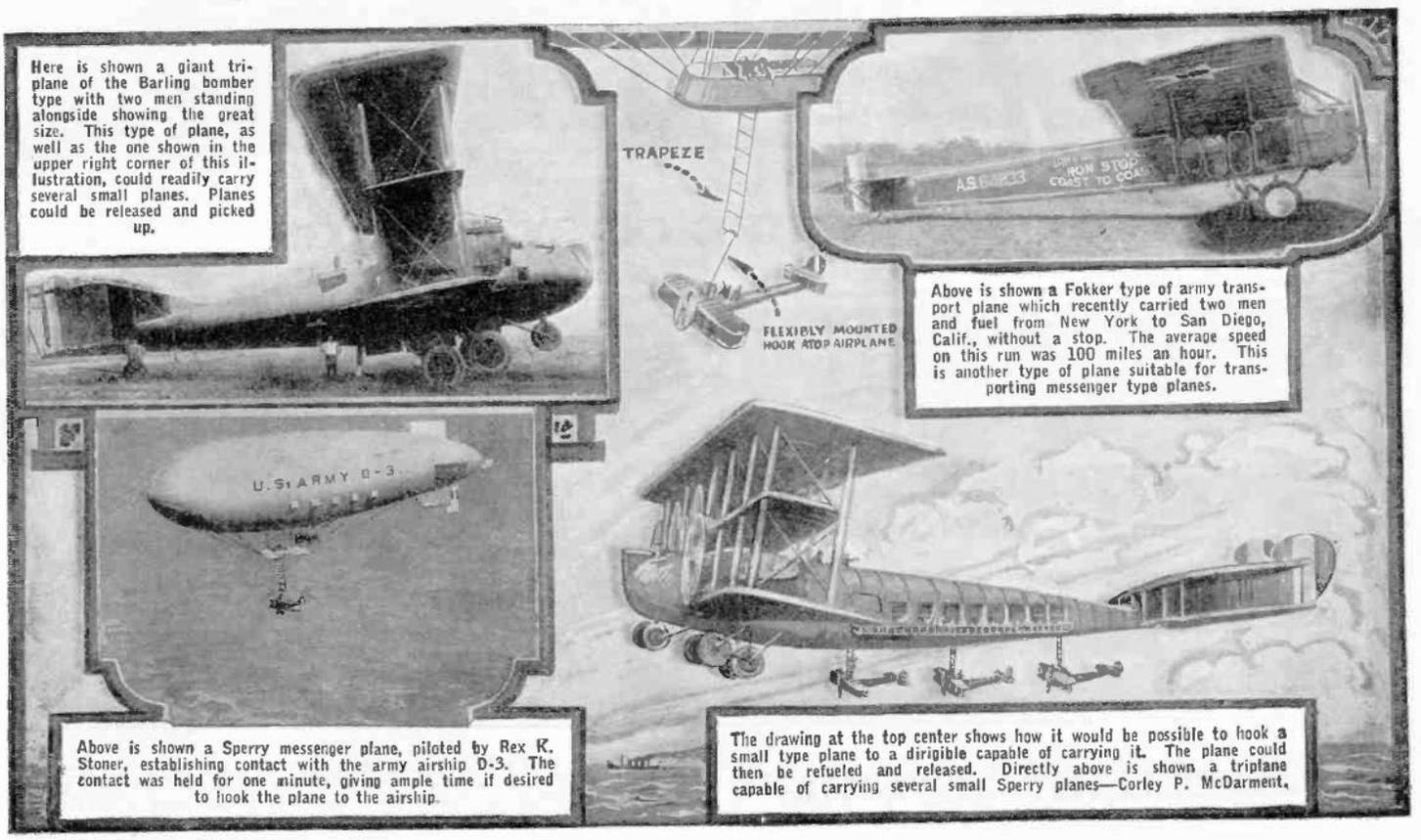
Two-Wheel Contact with Ground Increases Racing Speed



No matter how fast racing cars are designed to go, there is always a demand for more and more speed. This demand must be met and in order to do so those engineers who devote their entire time to the racing game have hit upon the idea of constructing a two-wheel automobile. This was suggested by the fact that motorcycles can travel at the rate of 100 miles an hour, while cars with three or more times the power only average about 116 miles an hour. However, in order to maintain the heavy engine of an automobile and the other correspondingly large parts in equilibrium it is necessary to provide a gyroscope in order to produce stability. Such a vehicle is illustrated above and we may soon see it tearing around the track at a speed of 175 miles an hour or more.

—Clarence A. Snyder.

Airplane Makes Contact With Balloon



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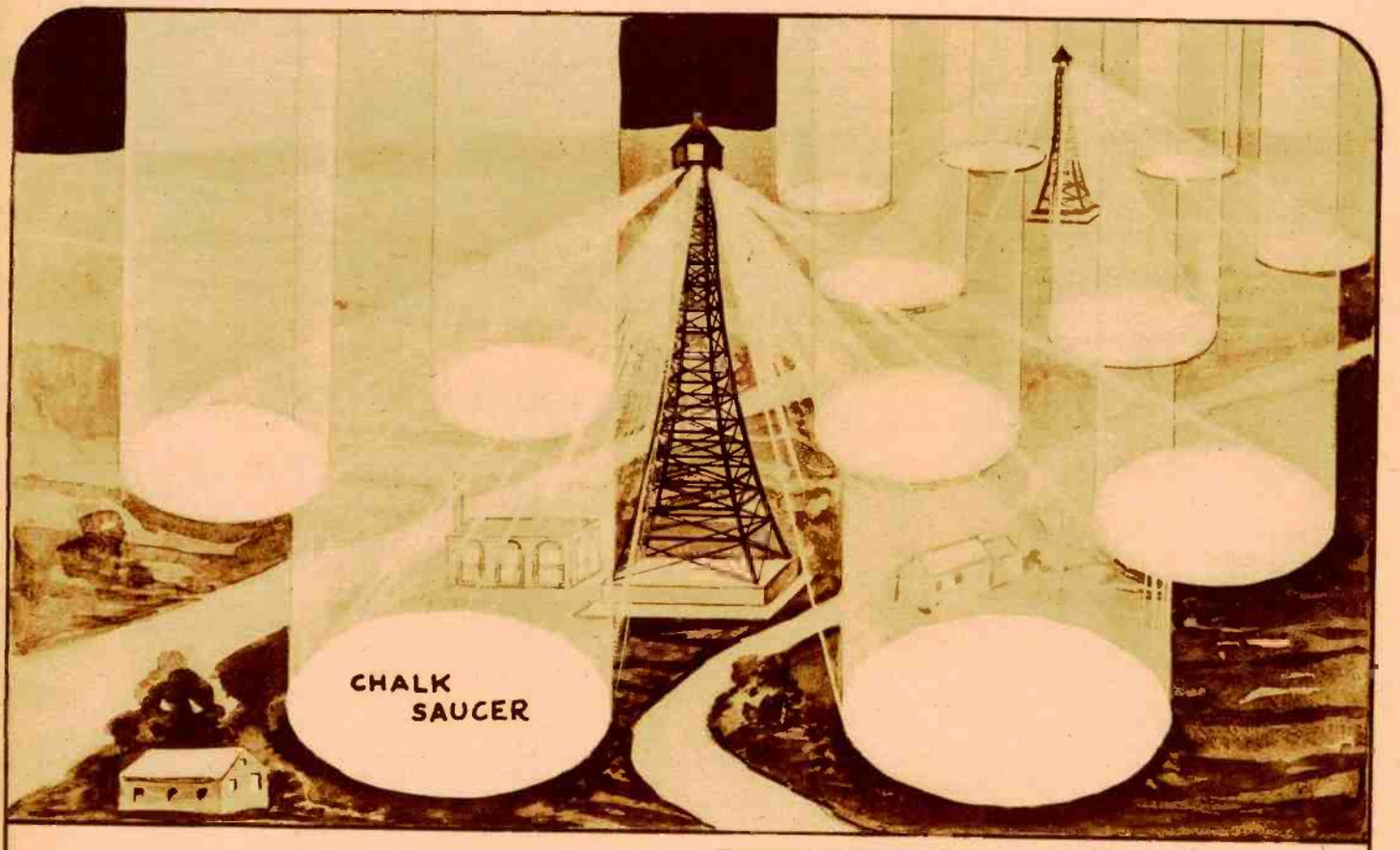
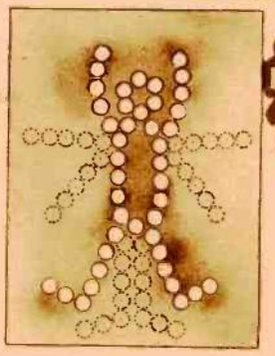
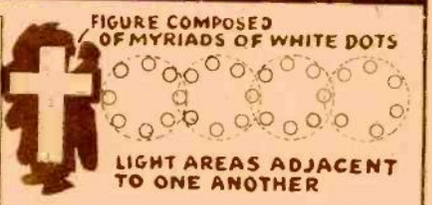
More Interstellar Communication

BY CHEVALIER DE TERRAIL



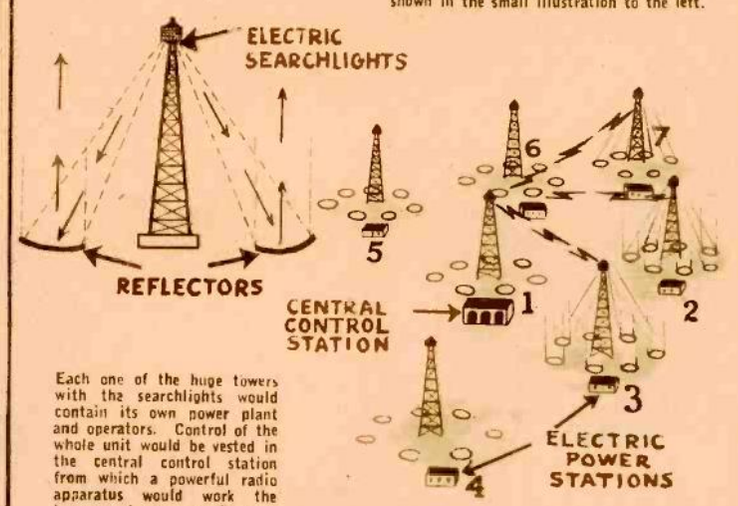
It is always interesting, the possibility of communicating with a sister planet. Here is the latest method—and seemingly one of the most logical and least complicated which has been put forward for some time. This system contemplates the use of huge chalk saucers as reflectors upon which are flashed the beams of powerful searchlights. Towers are erected at long intervals surrounded by a number of these saucers. By means of this system of illumination, a figure of a man or an animal is worked out over a large area. The completed figure may have a height running into the hundreds of miles, at least large enough to be visible from another planet. By making this figure movable through the agency of flashing the lights on and off, a definite sign could be given to another planet showing that life exists on the earth and that communication is desired. This would no doubt elicit an answer if the inhabitants of the other planet—presumably Mars—have reached a state of civilization at all similar to our own.





An idea of how the complete figure would be formed with the dots of light, is illustrated in these sketches. The idea is very similar to that used in half-tone printing, where a great number of dots placed closely together are used to give a solid image. The method of moving the arms or legs or head of the figure depicted, is obvious, since it follows the same principle as that employed in present day animated electric signs. This principle is shown in the small illustration to the left.

An idea of the image formed on the earth's face by this scheme is given in the above illustration. The huge form of the man or animal would stand out in distinct contrast, at night, against the black background of the earth.



Each one of the huge towers with the searchlights would contain its own power plant and operators. Control of the whole unit would be vested in the central control station from which a powerful radio apparatus would work the towers and power stations, as shown in the illustration here.

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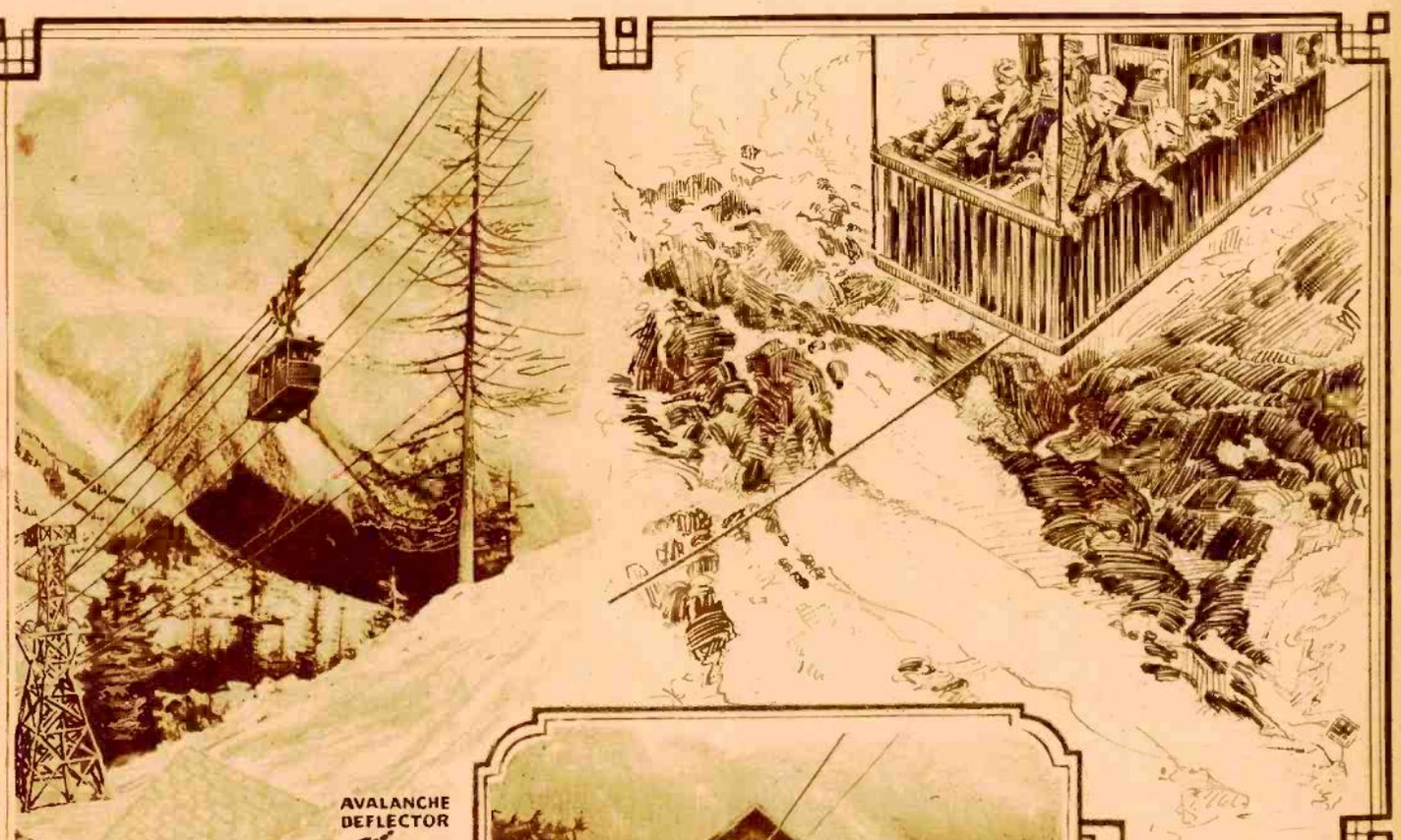
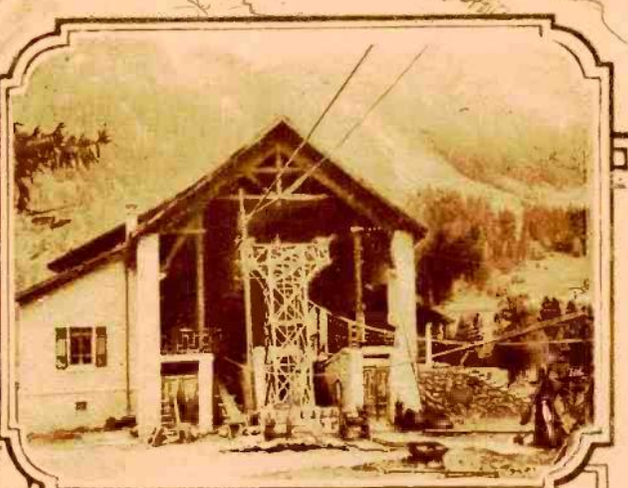
World's Highest Cable Railway

Highest Point of Aerial Railroad Almost Equals Mt. Blanc

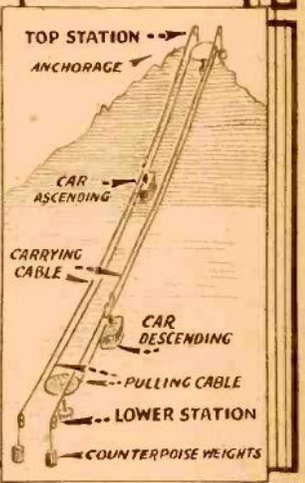
BY H. WINFIELD SECOR

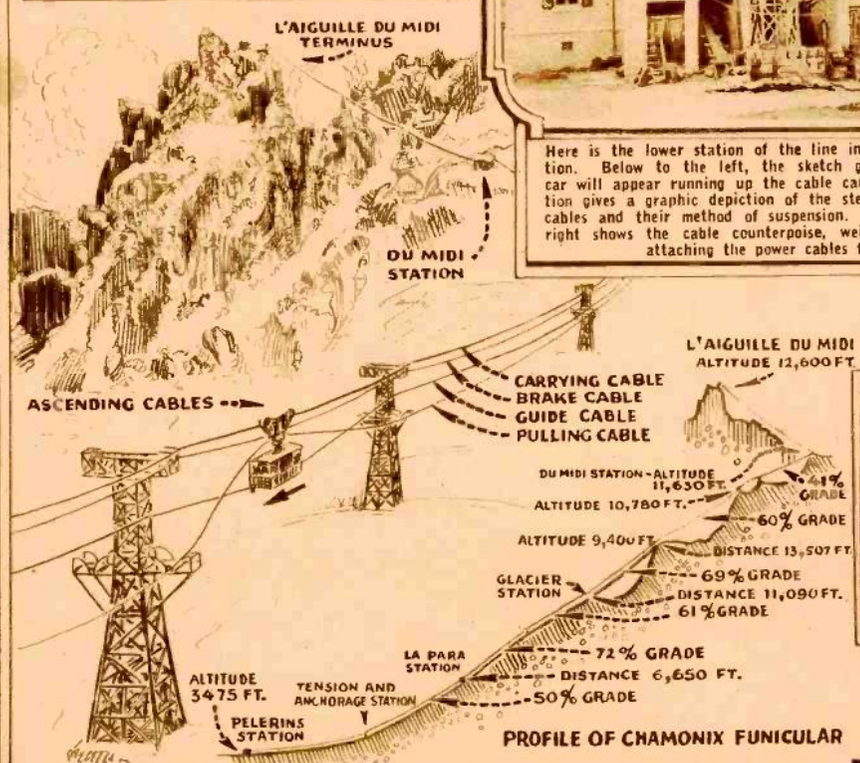


A cable railway rising over one of the roughest sections of the Alps to a height of 12,600 feet above sea level is in construction at Mt. L'Aiguille Du Midi, Switzerland. Its purpose is to carry tourists from the railway station at the foot of the mountain to a winter resort built at the upper terminals of the railway. At this resort it will be possible to carry on winter sports in July. The railway is a dual one.



Here is the lower station of the line in the process of construction. Below to the left, the sketch gives an idea of how the car will appear running up the cable carriers. Also, the illustration gives a graphic depiction of the steel tower supports for the cables and their method of suspension. The small sketch at the right shows the cable counterpoise, weights and the method of attaching the power cables to the motor.





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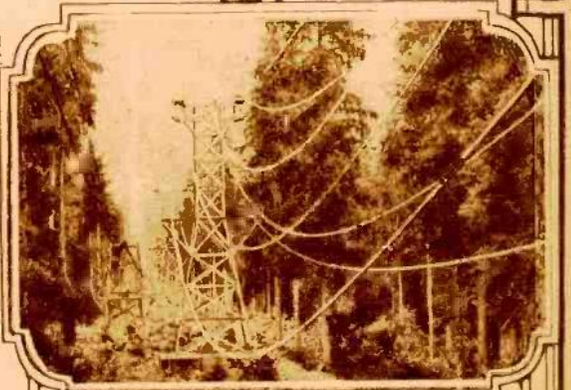

Here is shown a section of the aerial railway already completed graphically illustrating how the route passes over extremely rough country. No little difficulty was encountered in transporting the various materials.

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June

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Science and Invention

IN PICTURES

A NEW WATER SPORT WHEEL

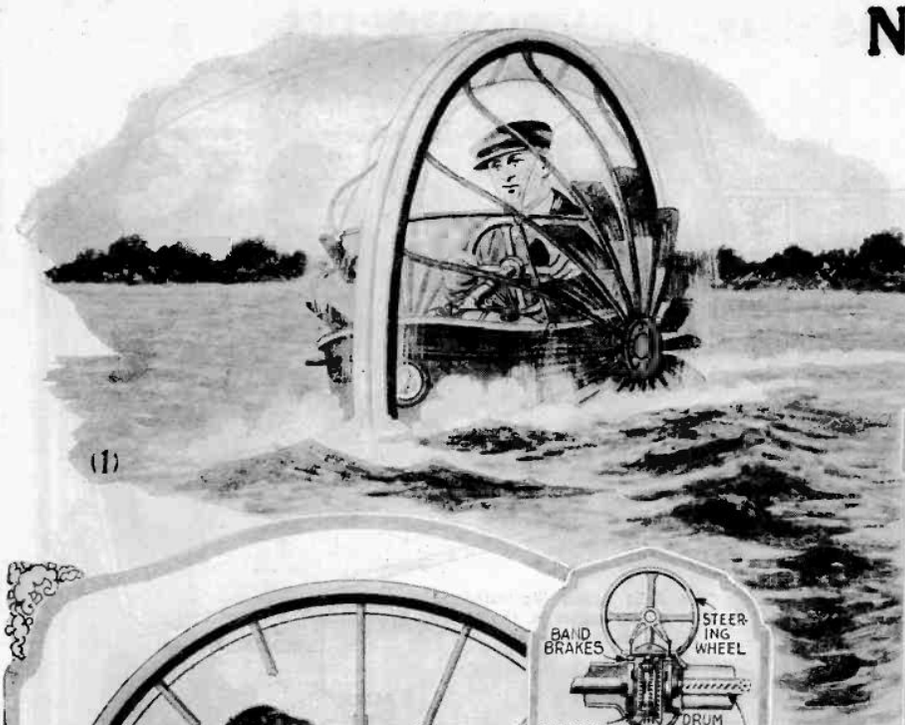
See Page 118

40 NON-TECHNICAL RADIO ARTICLES

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - THE EXPERIMENTER - MOTOR CAMPER & TOURIST

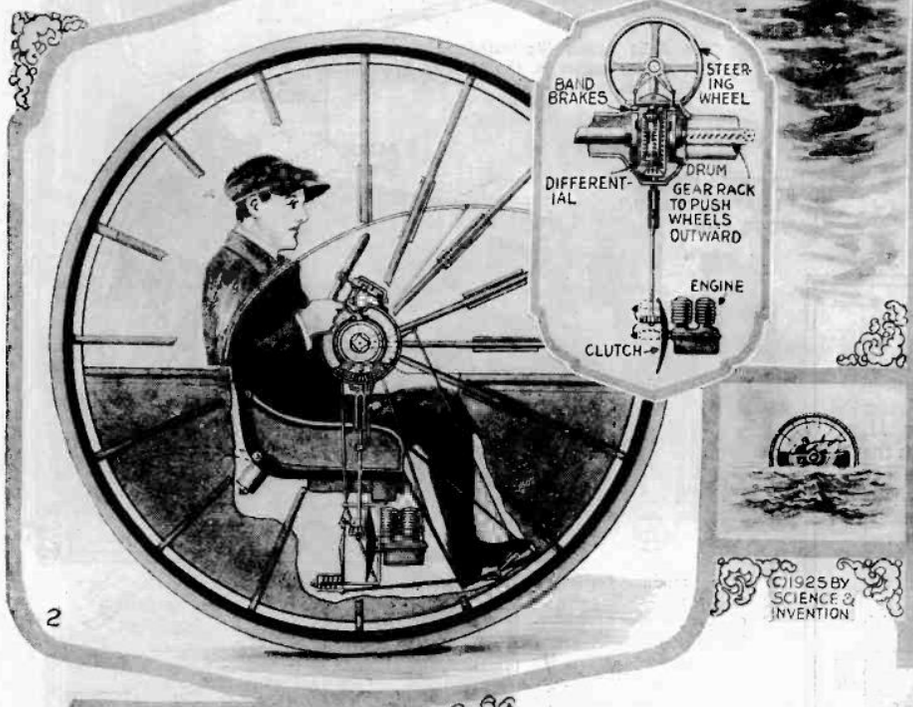
New Water Sport Wheel

By J. W. VON STEIN



(1)

THE new aquatic sport wheel seen in action in the water at 1 cn this page, is the invention of Charles F. Erickson. This sport wheel is amphibious. It will run both in the water and on land. It is driven by a small two-cylinder gasoline engine and overcomes the difficulty inherent in former unicycles, in that it is easily balanced whether the machine is moving or standing still. The body of the car is completely enclosed. The wheels themselves are capable of being extended from the body when so desired by the operator.



2

Illustration 2 on this page shows a side view of the machine and the steering control, as well as the position of the engine and operator. Notice here that the gasoline engine is swung beneath the seat. A large cone clutch transmits the power from the engine to a differential, and thence to the driving wheels. Both wheels are equipped with brakes, and when it is desired to steer the mechanism, the operator turns his steering wheel, tightening the brake on one side, which stops the movement of the corresponding wheel. The other wheel free to move the differential, travels a bit faster and consequently the entire mechanism is turned. The gear rack pushes the wheels outward when desired. Fig. 3 shows sectional rear view of the mechanism and illustration 4 shows the device standing still.

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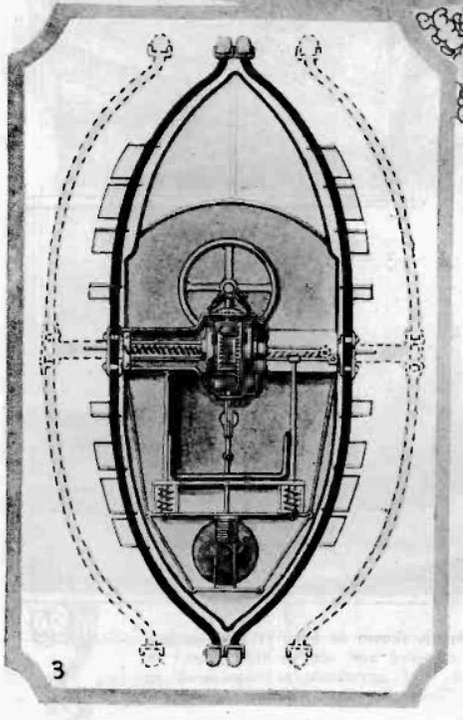

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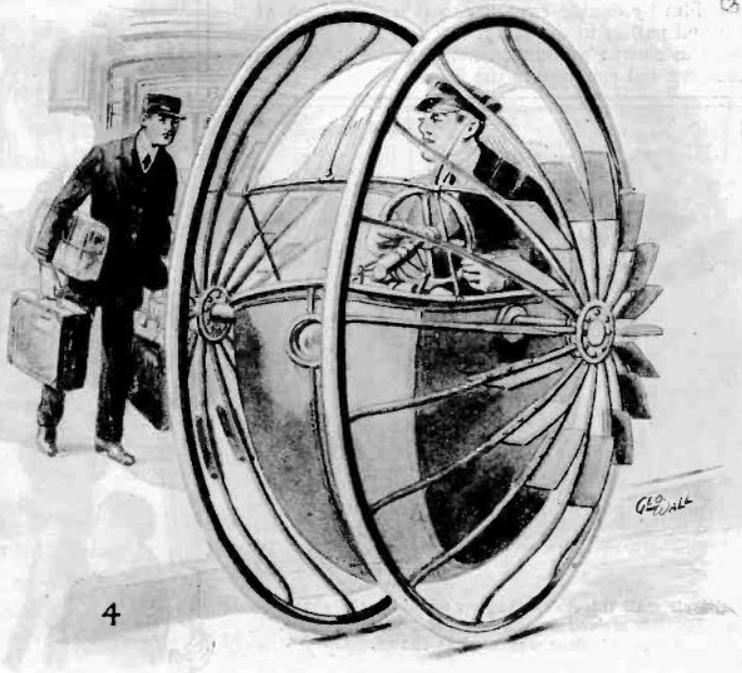
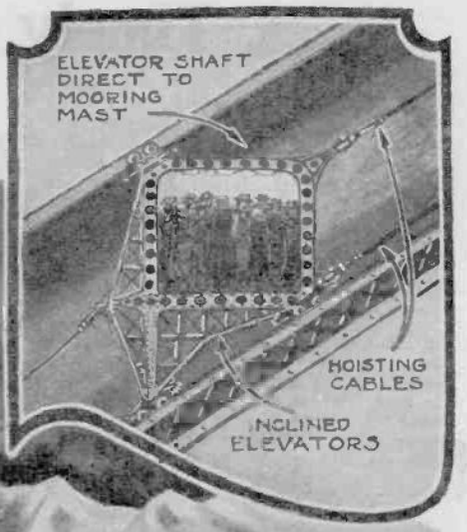
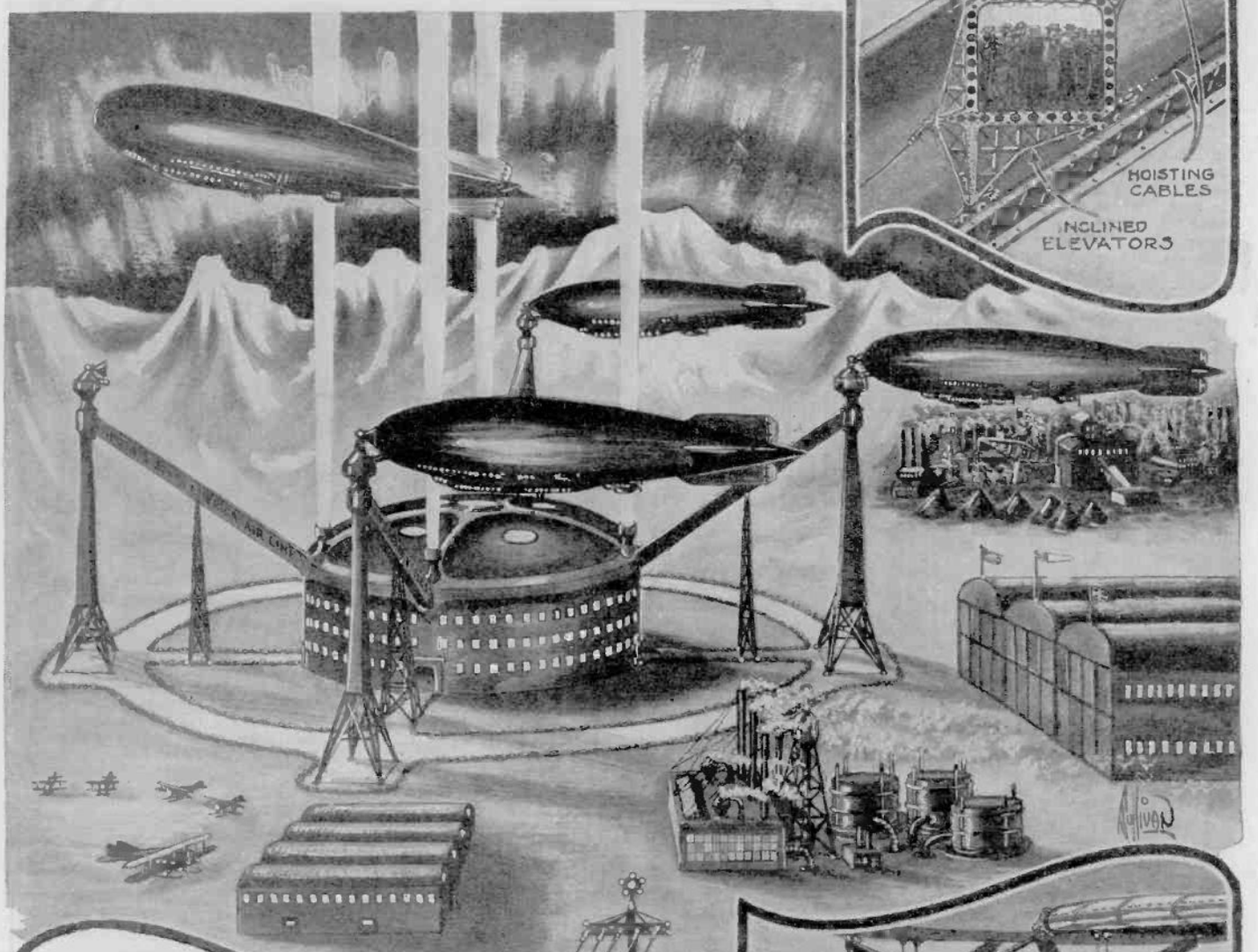


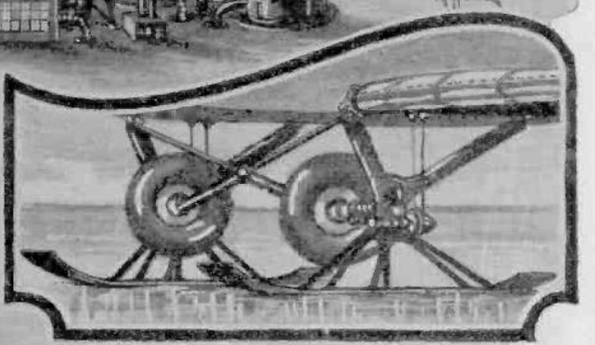
4

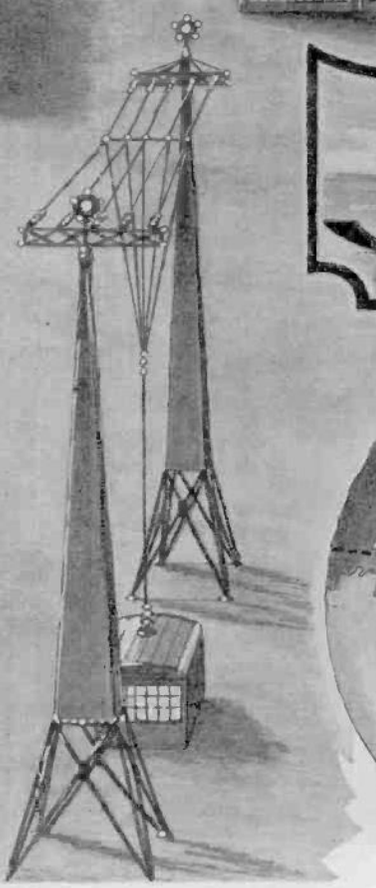
North Pole Junction

By L. B. ROBBINS



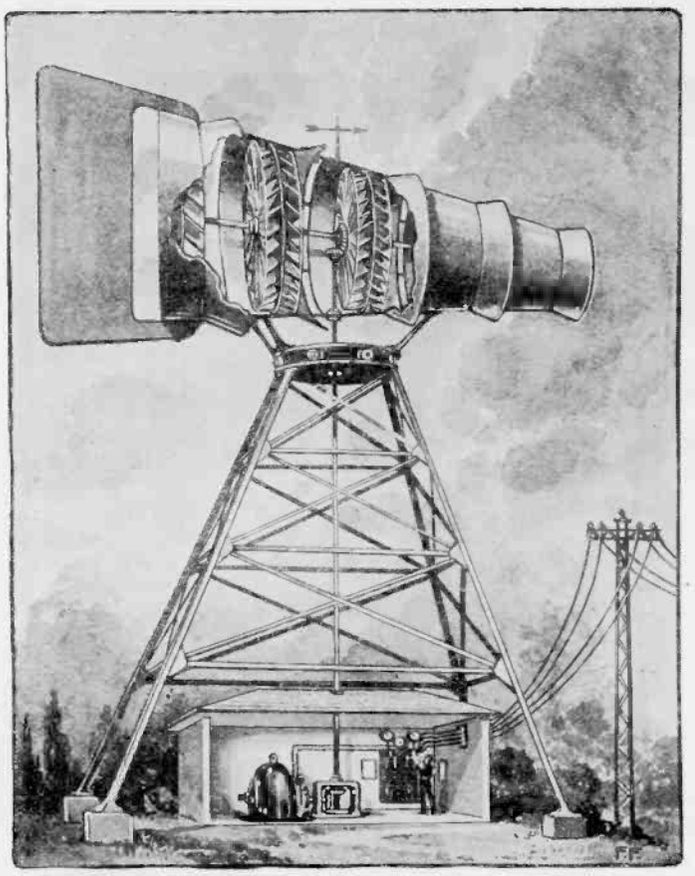


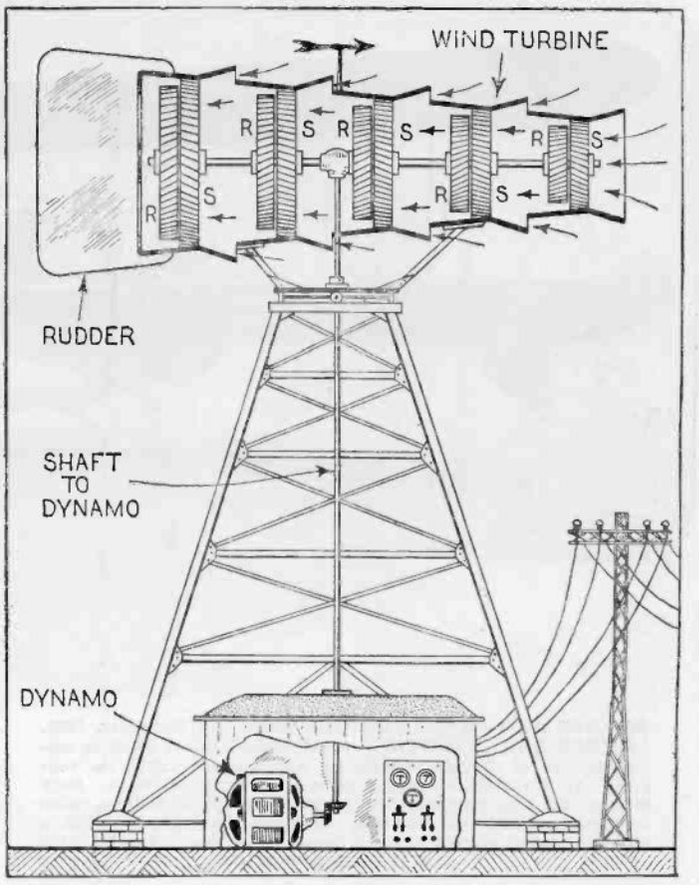




The illustrations on this page show a futuristic solution of the aerial transportation problem. The author contends that there will be a junction at the North Pole, where airships carrying passengers and freight will meet. Here ships from Russia will discharge their passengers and cargo, and take on other passengers and materials for the return trip to their home country. Those desirous of reaching America or those destined for Africa will travel down an inclined elevator shaft to a well lighted and heated waiting room, and will make themselves comfortable until the ship to the Americas or Africa leaves. There will also be stations along the Equator for short local traffic. This may be accomplished by means of airships or high speed airplanes. The northern regions are very rich in coal deposits, and there will be no difficulty in procuring petroleum cheaply or in manufacturing helium gas in these cold climates. As a matter of fact, the quantity of helium gas or petroleum produced would be greater than that in the more temperate sections of the country. This section will likewise have its own radio transmitter where local weather reports will be constantly transmitted to ships coming to the station or leaving it. The airplanes will be provided with skids, which may be let down so that landing may take place on a lake of ice or snow.

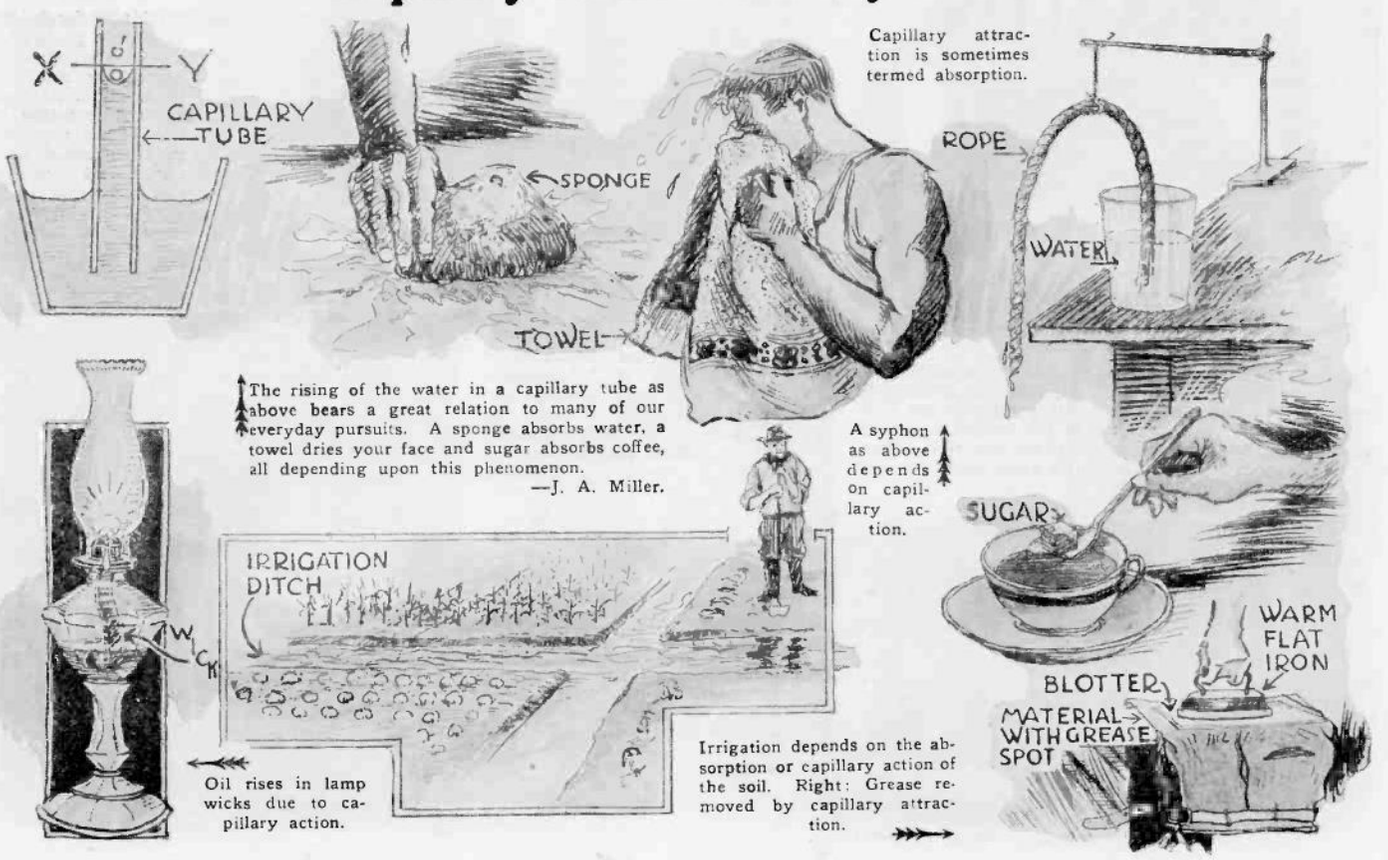
Novel Wind Turbine





A novel wind turbine of French origin has recently been developed. The device is illustrated in detail above. The drawing at the left shows the power plant in actual operation under working conditions, and the one at the right shows a complete cross section of the working parts and detail thereof. Wind enters the front, is concentrated through a cone shaped entrance and a stationary series of vanes against the first rotor. This it turns and then proceeds to the second rotor. Here it is reinforced by wind entering the second opening and is again concentrated on a rotor. The procedure is followed throughout. The rudder keeps the entire device facing the wind.

Capillary Action in Daily Life



Sept.

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Science and Invention

IN PICTURES

LIFE SUSPENDED IN ICE

See Page 406

40 NON-TECHNICAL RADIO ARTICLES

EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
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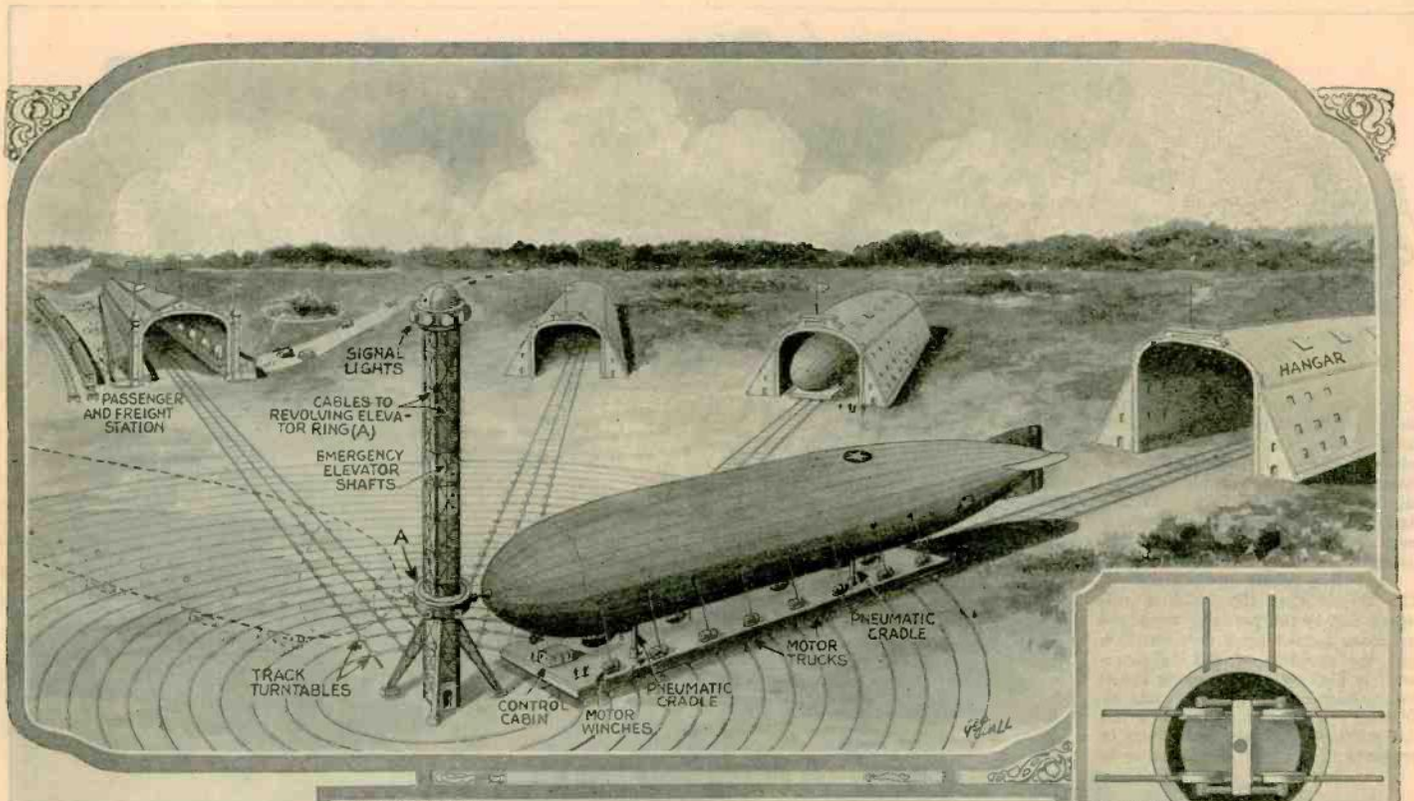
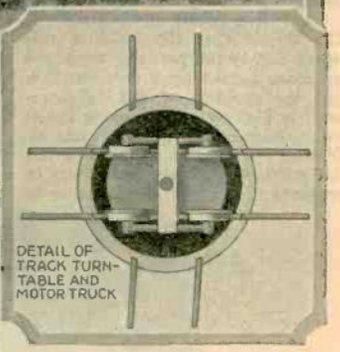
Dirigible Mooring Mast and Landing Platform

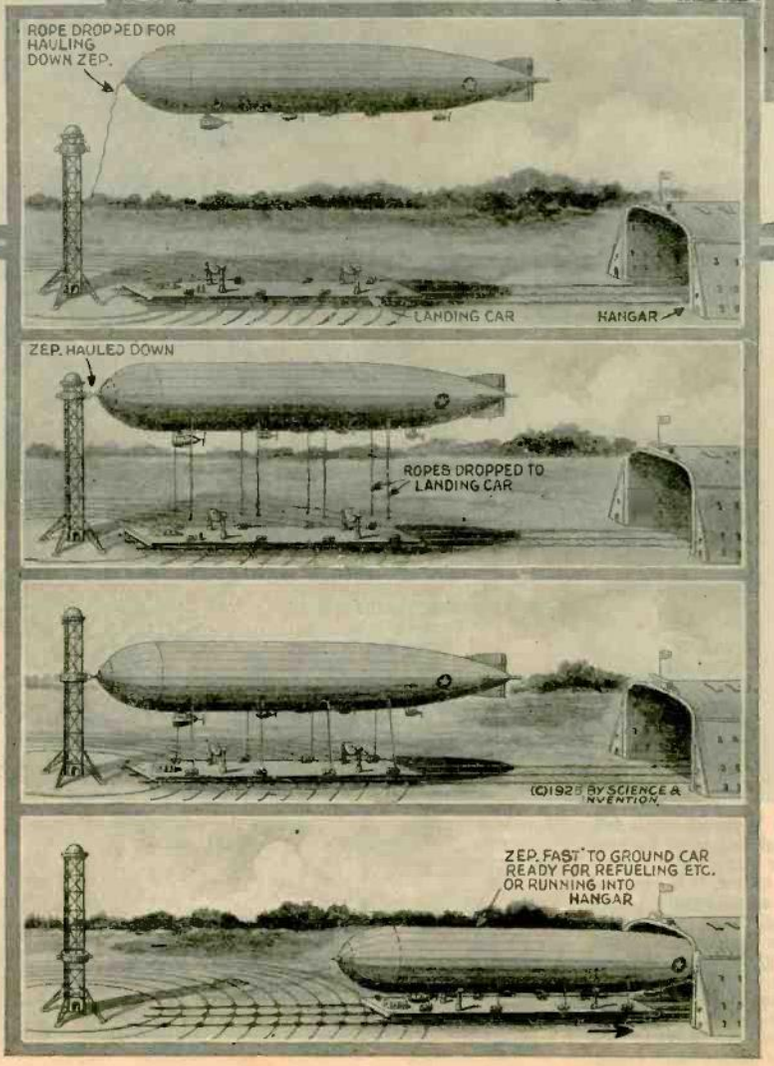
This Device Provides for Comfortable Landing Facilities



The illustration directly above shows the dirigible in position on the landing car and the dotted lines show how it can be shifted and reorientated according to the wind. Progressive drawings at the right show the various stages of landing.



Above: Details of track turntables which are indicated in the drawing at left above.



This new type of combination mast and landing platforms for dirigibles, designed by Joseph B. Strauss, Chicago engineer, who prepared the designs for the great 4,000-foot bridge across the Golden Gate, consists essentially of a stationary mooring mast and a movable landing platform which is capable of being rotated around the fixed mast as a center or of being drawn into the hangar. This platform is mounted on wheels placed in a series of trucks, as in the insert in the upper right-hand side of this page. The rails upon which the wheels travel are equipped at intervals with turntables, by means of which the trucks can be turned through 90° to adjust the wheels to travel on the circular rails. Similarly, they can be transferred from the circular to the straight tracks. In this way, after landing, the dirigible can be guided into any one of the hangars.

The details of the method used for mooring a dirigible to this new mast are given in the four progressive drawings at the left. First, a line is dropped from the nose of the ship and its end is raised to the top of the mooring mast by means of an elevator. This rope then pulls the nose of the dirigible down until it fits in the socket provided at the top of the tower. Other ropes are then dropped from the ship as in the second illustration and are fastened to winches on the landing car. The ring to which the nose of the ship is moored is then lowered on the mast, while the winches take up the slack in the mooring ropes. Gradually the ship settles until it is securely fastened to the landing car. The entire ship can then be run into a hangar for refueling or for taking on passengers and freight. Thus the work and risk involved in landing a ship of this nature is reduced to a very great extent.

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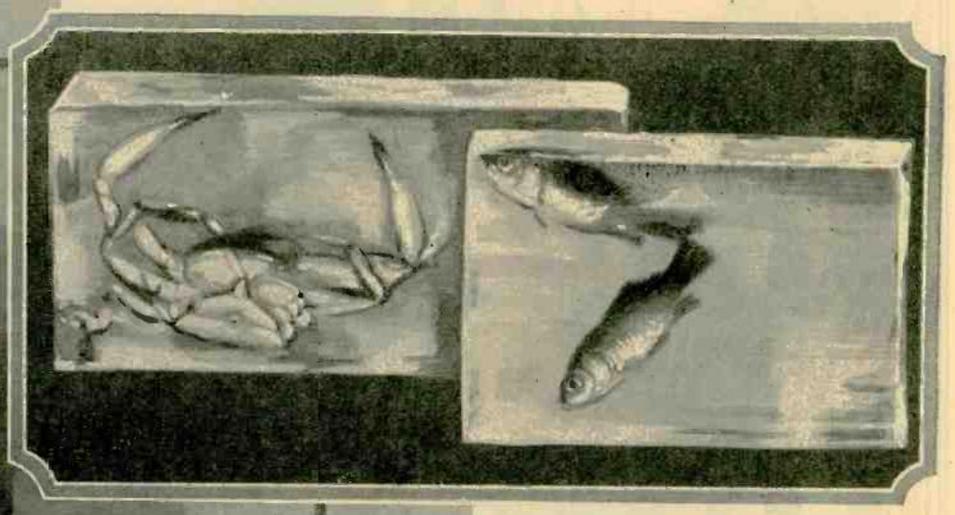
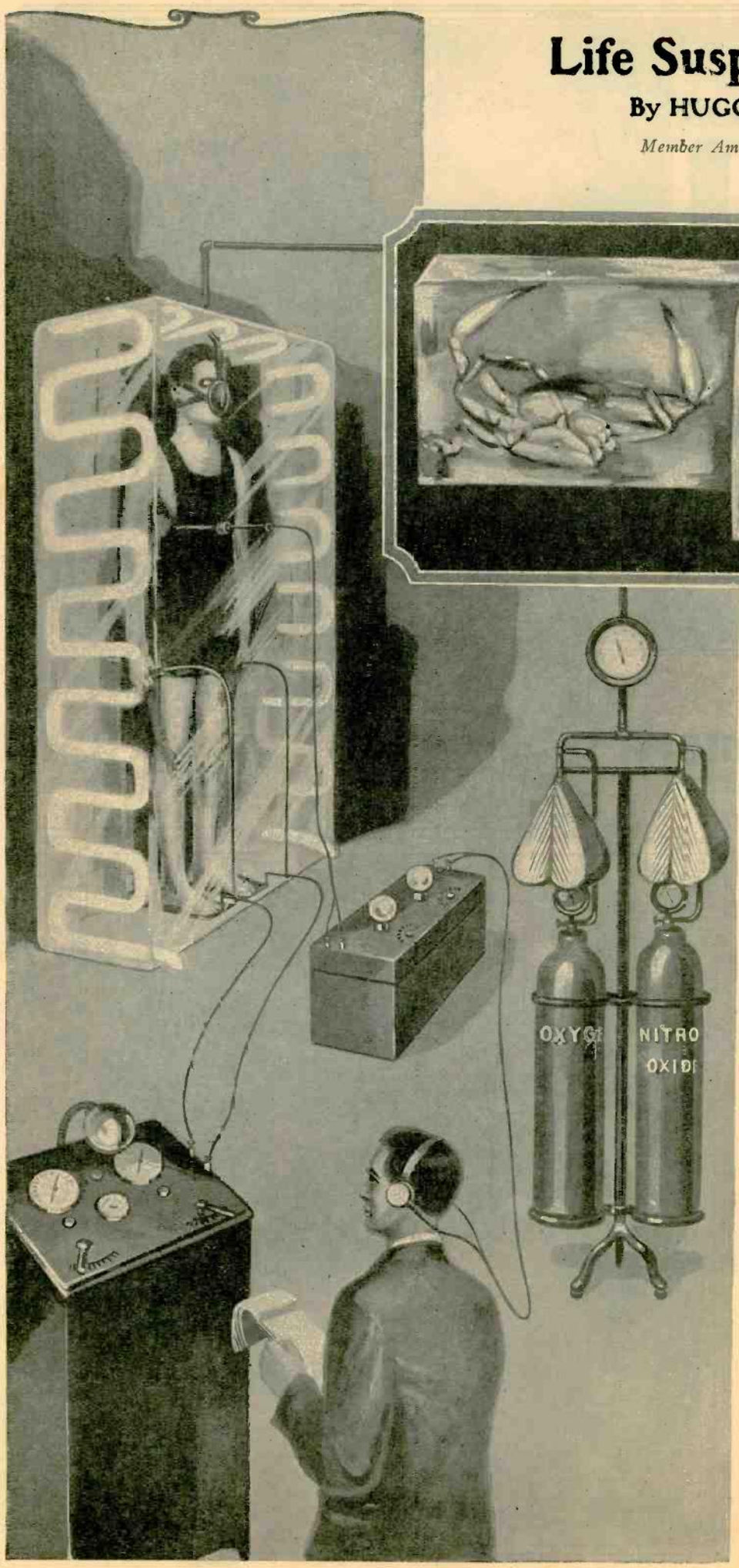
Life Suspended in Ice

By HUGO GERNSBACK

Member American Physical Society





SOME time ago we ran a fiction story, "The Living Death," by John Martin Leahy. Our readers will remember that in this story the explorers came upon a girl who had been frozen in ice for many years and when the explorers thawed her out, she came to life again.

When we ran this serial, a surprising number of letters were received by the editors, many people wanting to know if there was some process by which this could be done, or whether it was pure fiction.

Textbooks and other scientific books, as well as scientific articles, have appeared many times, showing that fish and other forms of life, after being frozen solid, came back to life when thawed out.

We, therefore, thought it best to actually make some experiments to find out whether there was any truth in such contentions and whether or not it was possible to bring back to life living organisms that had been frozen for any length of time.

The writer thought of making the following experiment: He reasoned that, if you take any living organism having blood circulation and freeze it, the blood vessels freeze first. The blood itself then freezes and, in doing so, expands. This expansion bursts the already hardened veins and arteries, making later resuscitation impossible. On the other hand, the thought occurred to him

The photos at the top of this page show our experiments in freezing fish and a crab in two separate blocks of ice. The fish and the crab were frozen very slowly, so that we artificially reproduced the effect in nature. Even though many writers stated that they had seen fish frozen in ice come back to life again after they had been thawed out, our own experiments seem to disprove this theory. When we thawed the fish and the crab out again, they did not come back to life. As a matter of fact, they would not even respond to electrical stimulation.

The illustration on the left is based upon the theory that if we could suspend animation, instantaneously, there would be no disintegration of tissues, and life could probably be restored again. The diagram illustrates an immense tank of water in which are the cooling tubes. Nitrous oxide is used to cause a state of sleep when the process is started and oxygen is used for subsequent stimulation of the patient. Heart sounds are amplified before they reach the physician's ears, and an endotherm stimulates blood circulation.

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that if the freezing were to be done so rapidly that there was no chance for the individual blood vessels to expand and burst, then, perhaps, there might be some chance of reviving the organism.

That this thought was partially correct was proved afterwards.

We first took a goldfish and put it in a cardboard tray. We then poured liquid air over it, and this froze the fish very rapidly. The boiling point of liquid air is —191 degrees Centigrade or —311.8 degrees Fahrenheit.

When the fish was thawed out afterwards, in tepid water, he appeared dead. The writer then took two radio "B" batteries, giving a tension of about 90 volts, and proceeded to attempt resuscitation of fish electrically. This was done, as shown in the illustration; namely, by placing one wire in the water near the tail of the fish and dipping the other wire rapidly and intermittently in the water. This, of course, opened and closed the circuit, and part of the current traveled through the fish.

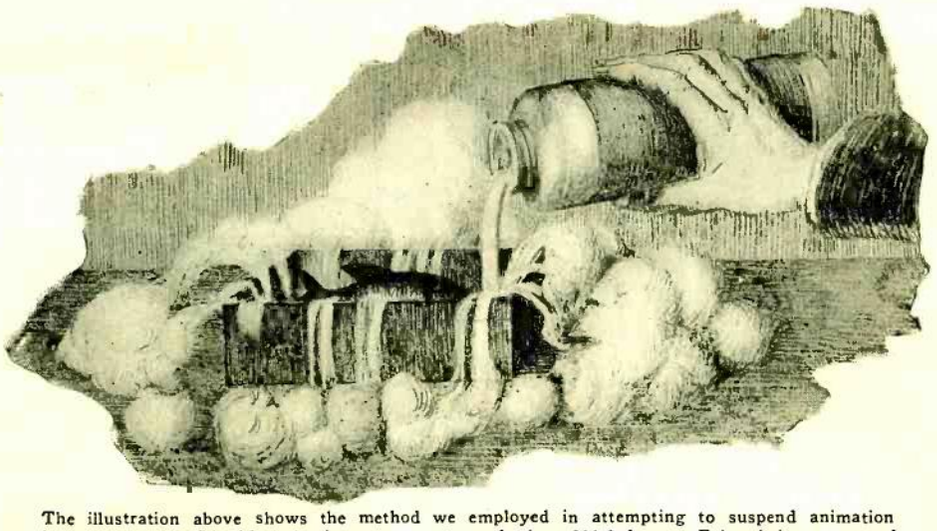
An immediate reflex action was noted, and it could be seen that the fish's gills worked convulsively, and the tail, as well as the fins, seemed to have some life.

The resuscitation process was continued for some minutes, but the fish did not return to life. Only this one experiment was made, but its effect has been sufficient to encourage the writer to think that, if other forms of life, perhaps not as delicate as a goldfish, were frozen, and after thawing out, electrical resuscitation were resorted to, some specimen might be found that will be revived.

The theory of using liquid air is that the freezing process will be done so quickly that the blood vessels will have no time to expand and burst, although, of course, there is a chance that they might do so on thawing out.

Nevertheless, in the liquid air experiment, no decomposition of the fish had set in, although similar fish, frozen in ice, started to decompose almost the instant thawing commenced.

The next experiment was to take similar goldfish and freeze them in a pan by artificial Frigidore refrigeration. Our illustration shows how this was accomplished. Two fish were used in the experiment. They were slowly frozen and slowly thawed out. After thawing out, the fish showed decomposition at the fins. There was no reflex effect at all when they were treated electrically, with many different voltages. The nervous system of the fish apparently was just as dead as the fish itself. There was no trace of muscular reaction due to nerve stimulation, as was the case in the liquid air experiment.



The illustration above shows the method we employed in attempting to suspend animation instantaneously. Liquid air having a temperature of minus 311.8 degrees Fahrenheit was poured upon the fish, which in this instance was placed in a cardboard box. The fish, of course, was frozen almost instantaneously. Every attempt to bring the fish back to life again failed. Although the fish frozen with liquid air responded to electrical stimulation, there were no voluntary movements at any time.

The same experiment, that is, using the usual ice-freezing means, was next tried with a crab, with the same negative results. After the crab had been thawed out, no reflex of any nature could be observed, the freezing apparently having killed the crab as completely as it had disposed of the goldfish.

The conclusion to be drawn from the experiments is that it is not possible to bring living organisms, after freezing, back to life. The statement found ever so often in text books, that fish in ponds have been frozen solid and thawed out in the spring, may, therefore, be questioned.

Probably upon the approach of a freezing temperature the fish go to unfrozen regions at the bottom of the pond or lake and stay there until the ice thaws out, but we doubt very much if fish actually freeze and then come back to life. There may be certain species that do so, but we have yet to find them.

Our cover illustration shows a problematical experiment where this freezing process is applied to a human being. In connection with a warm-blooded being, as our experiments have shown, a slow freezing would be out of the question. If some means could be found of *instantly* producing a greater cold than that of liquid air, as, for instance, absolute zero, there is just a possibility that at some future date a human being might be frozen instantaneously. This would immediately stop all the various organic processes, and there would be no time for the blood vessels to burst, because the entire body would be frozen in an instant.

It would, of course, be necessary to provide the subject with a mask over his mouth and nose, with a pipe leading to the outside, so that in the ensuing thawing out the subject would not drown—hence the mask as shown in our illustration. An endotherm might be employed to cause the arteries to expand and contract as the current is intermittently turned on and off.

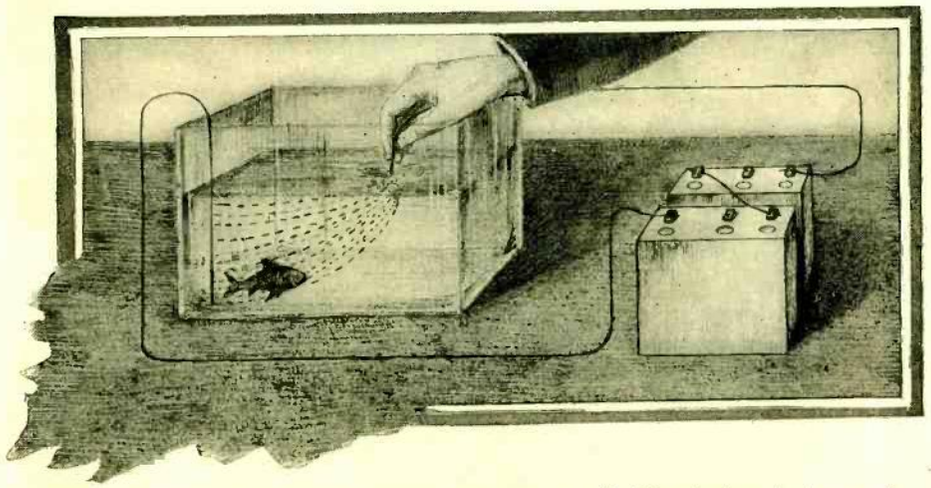
As soon as the thawing-out process begins, the resuscitation could be effected by vibratory electrical currents, and there is a chance that the subject would then come to life again.

Of what use would such an experiment be? Frankly, we do not know, but for biological reasons and for scientific purposes, many things might be discovered during such an experiment that are entirely hidden from us now.

For instance, there are a number of diseases which, under such a treatment, might possibly vanish altogether. Certain bacteria, certain infectious diseases, might be stamped out entirely by a few hours' freezing treatment of this kind. We know from previous experiments that tissue and flesh can be preserved sometimes for years when frozen in ice. We also know that at present most low organisms are killed off, by the icing process. All this is an argument that the freezing process, if it can ever be effected, will in time to come be of great interest to humanity, very much more so than we can discern today.

Furthermore there are a great many sufferers of various diseases for which no cures have as yet been found. If we were able to suspend animation for a period of years, we could take those afflicted with incurable diseases and place them in a large sanitarium and suspend animation there. Attendants would be on hand at all times to keep the temperature constant and to maintain a vigilant watch over those in the frozen state. In later years when scientists actually discover a method for relieving the sufferers of malignant diseases, those afflicted with the particular disease for which a cure has been found, could be brought out of the sanitarium and thawed out to be treated the instant they show signs of life again. Of course this is pure theory.

Refrigeration during the past forty years has done wonders for mankind, our big cities could not possibly be without it today, as they are dependent upon frozen meat from outside



The above illustration shows how attempts were made to artificially stimulate the heart and incidentally stimulate the muscles of the fish, so that the mouth and gill covers would move, causing a flow of water over the gills. One wire from the "B" batteries was led to the bottom of the water, and another bare wire intermittently touched the surface of the water. The current passing through the fish caused muscular twitchings which did not, however, resuscitate the creature.

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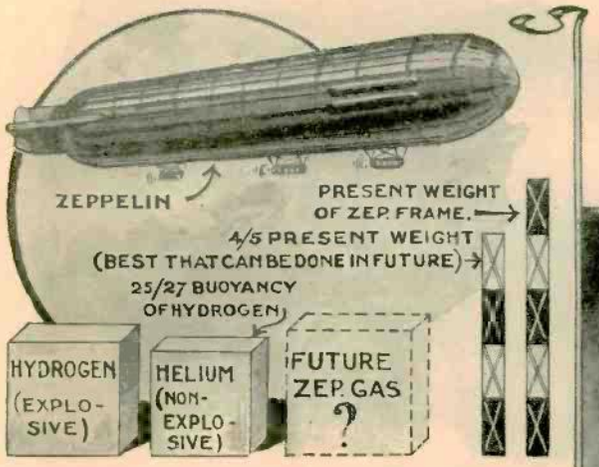
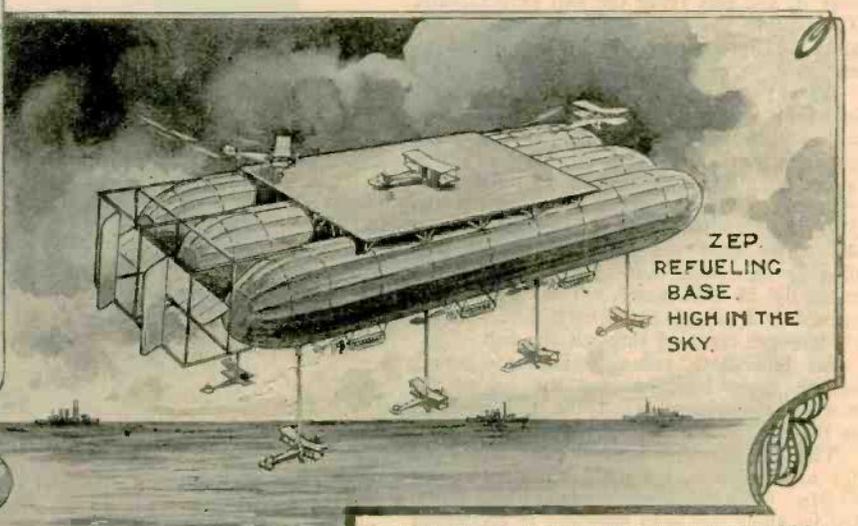
Airplanes and Tanks in the Next War

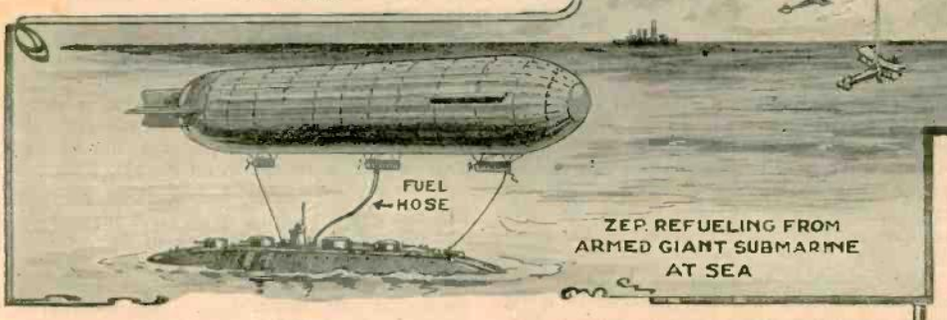
By H. WINFIELD SECOR, E. E.

SUBJECT OF A TALK GIVEN BY AUTHOR AT WRNY, JUNE 23rd



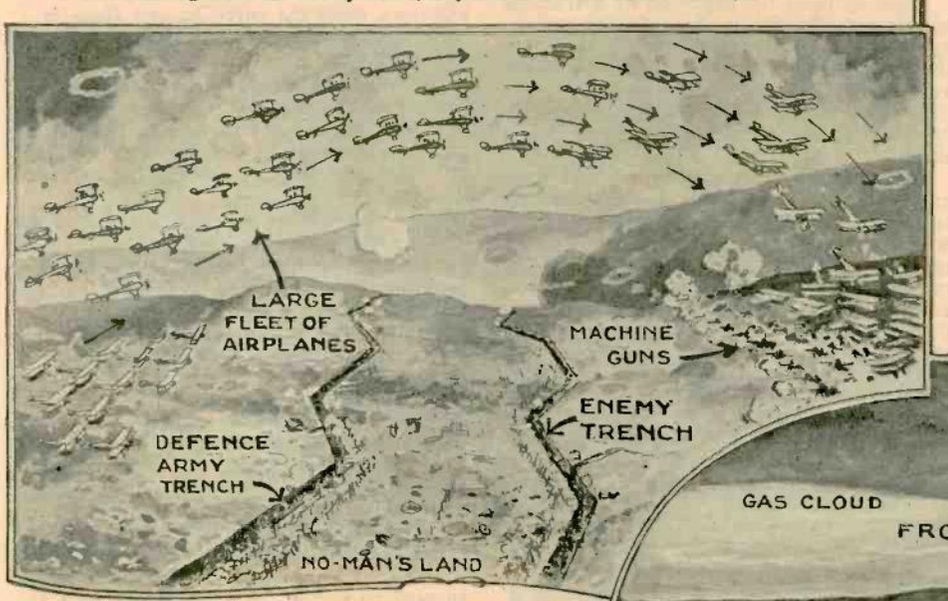
As pointed out by Prof. Norris F. Hall, of Harvard University, in an interesting new book, "The Next War," the factors concerning dirigibles align themselves as above. A substitute for helium is improbable. Hydrogen mixed with air is combustible.

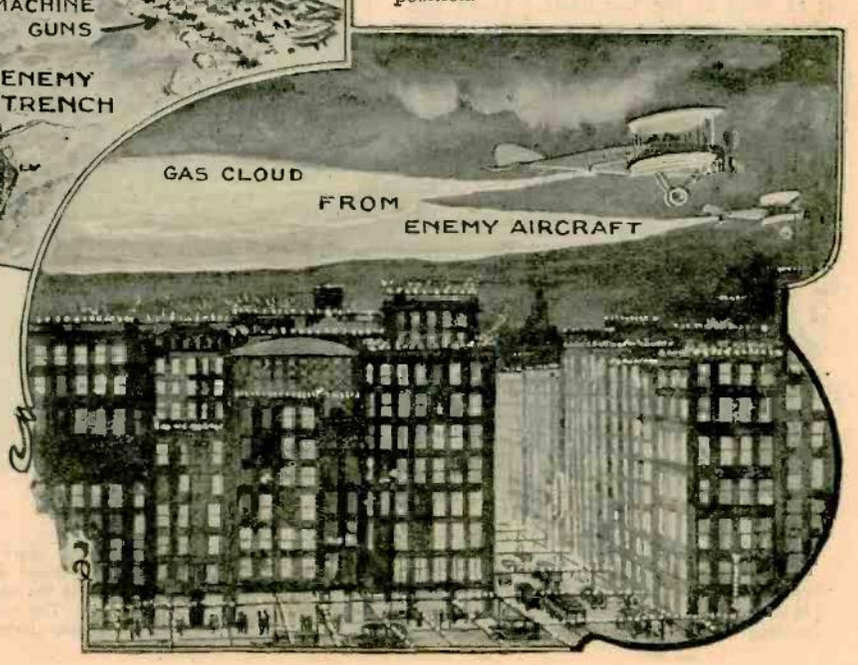




In his interesting prediction of the role of science in future wars, Prof. Hall predicts that airplanes will refuel in the air, landing on a dirigible supported platform or else connecting with suspended cables and hooks. Zeppelins may refuel from giant submarines at sea, as shown in the interesting picture above. If the dirigibles are filled with non-inflammable helium gas and are heavily armed, they will have a fair chance in battle.

THE next war, even if waged within a few years, will be one fought by airplanes and tanks, say our scientists. The infantry will be infantry no longer, for they will go into battle encased in tanks. The reason why the tanks will have such a large share of the work in any future great wars, is due to the fact that first, the men are fairly well protected as compared with their position in trench warfare, and secondly, the tanks are mobile and can transport a large number of troops, which otherwise might be trench-locked for months. A picture of a tank and airplane battle in a war of to-morrow presents a startling spectacle to the mind's eye. Picture hundreds, yes thousands of tanks, traveling over the ground at speeds of twenty-five to thirty miles per hour, knocking down trees, and buildings as they go, and wallowing through seas of water, mud and gas. Military experts are now devising and building tanks which can travel thirty miles per hour or more, and they are being designed gas-tight and water-tight as well. Troops will be moved by huge fleets of tanks as well as by airplanes, and the illustration at the left shows troops being transported to a flanking position.





IN the next war, if it should occur, one of the greatest problems the army experts will have to solve will be how to protect our cities and towns from gas attacks by the enemy. Imagine for a moment what it would mean if enemy airplane carriers or large submarines carrying collapsible aircraft, should make a gas attack at night on a city like Philadelphia or New York. It does not take very much gas, such as Lewisite, to render a city uninhabitable. If such an attack was made unexpectedly, or at the start of hostilities, the fatalities would be enormous without a doubt. It seems to the writer that one way of combatting a gas spread over a city would be to lay down a neutralizing gas cloud from other aircraft. Prof. Hall describes the scheme illustrated at right, comprising thousands of gas jets kept burning over buildings and streets.

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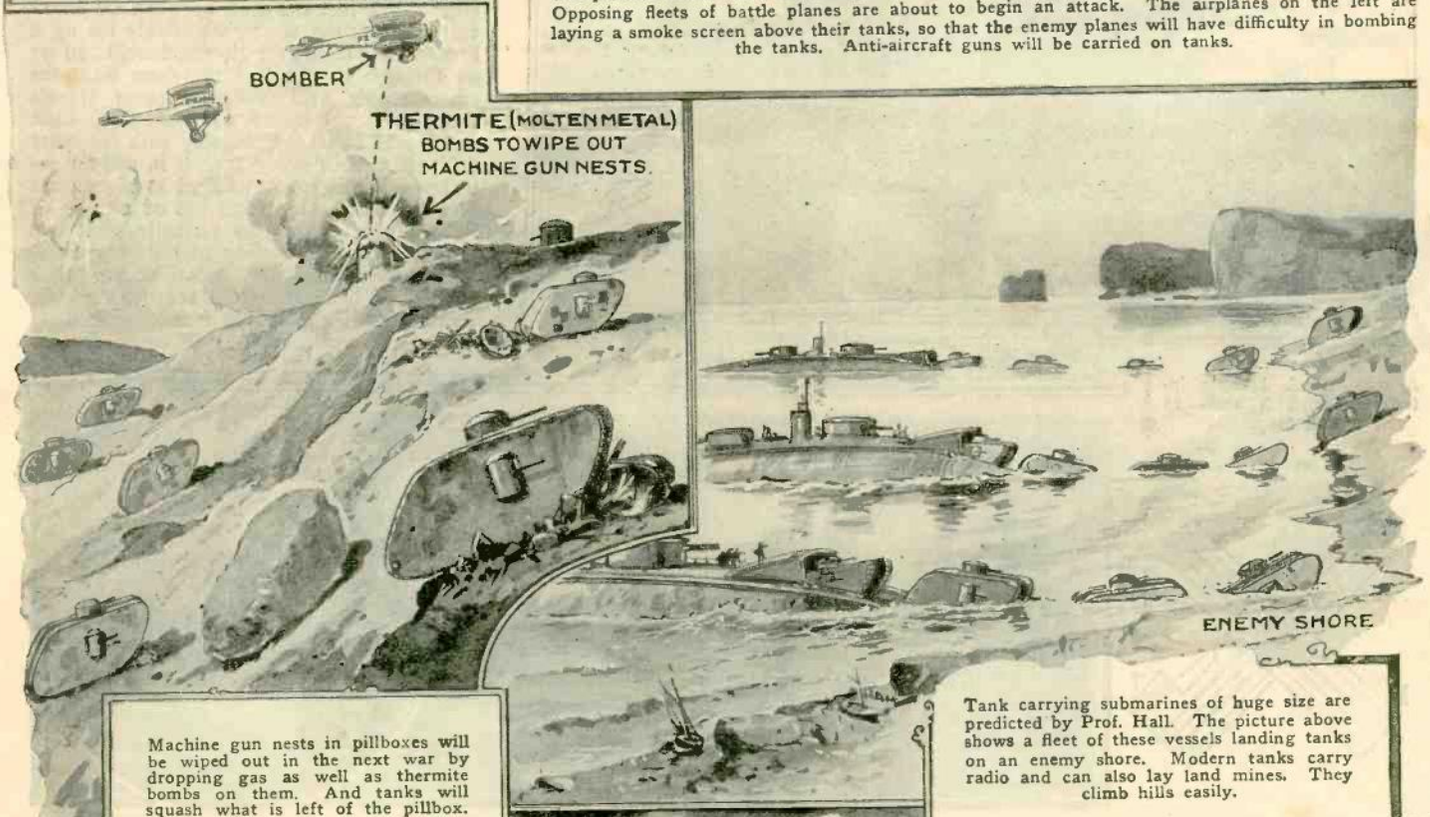
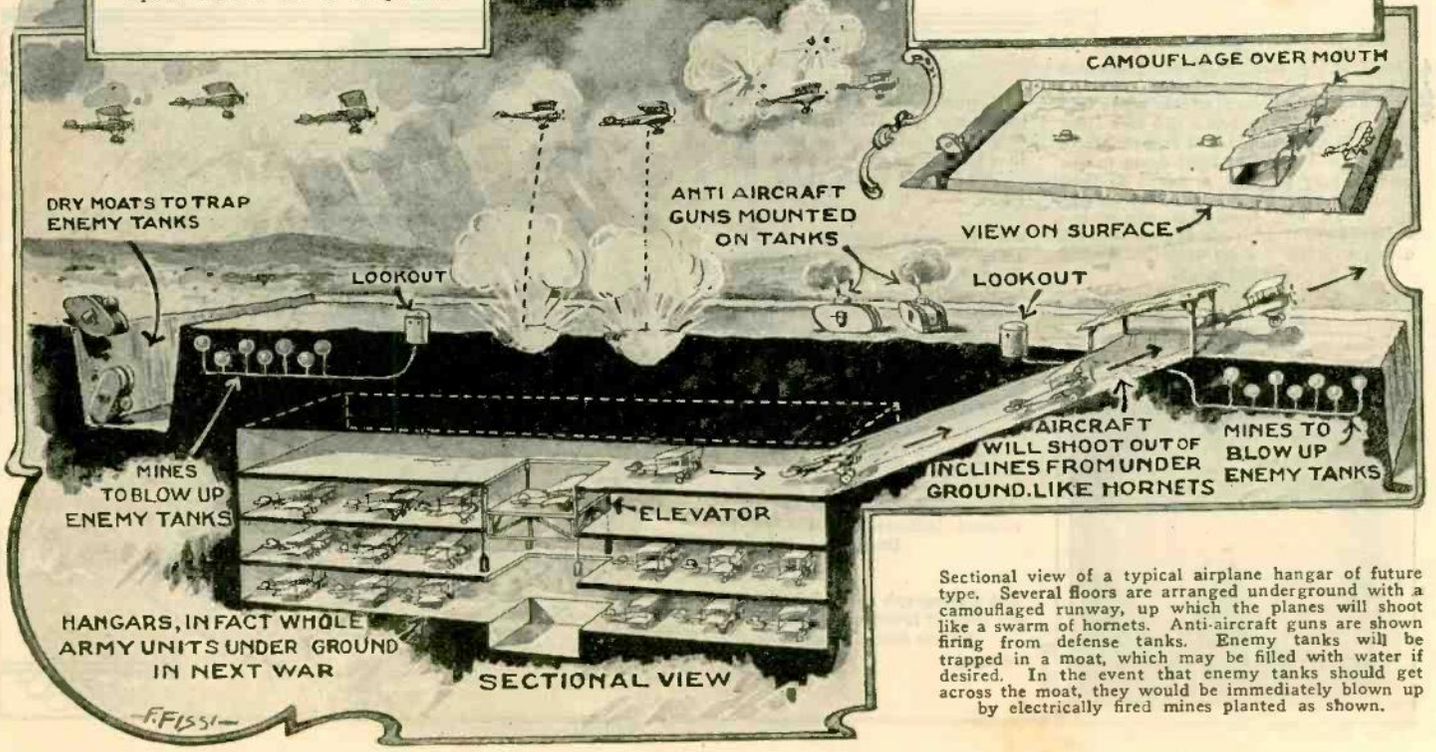
The pictures above show camouflaged tank and two corps of tanks attacking each other. Above: Opposing fleets of battle planes are about to begin an attack. The airplanes on the left are laying a smoke screen above their tanks, so that the enemy planes will have difficulty in bombing the tanks. Anti-aircraft guns will be carried on tanks.



Machine gun nests in pillboxes will be wiped out in the next war by dropping gas as well as thermite bombs on them. And tanks will squash what is left of the pillbox.

Tank carrying submarines of huge size are predicted by Prof. Hall. The picture above shows a fleet of these vessels landing tanks on an enemy shore. Modern tanks carry radio and can also lay land mines. They climb hills easily.



Sectional view of a typical airplane hangar of future type. Several floors are arranged underground with a camouflaged runway, up which the planes will shoot like a swarm of hornets. Anti-aircraft guns are shown firing from defense tanks. Enemy tanks will be trapped in a moat, which may be filled with water if desired. In the event that enemy tanks should get across the moat, they would be immediately blown up by electrically fired mines planted as shown.

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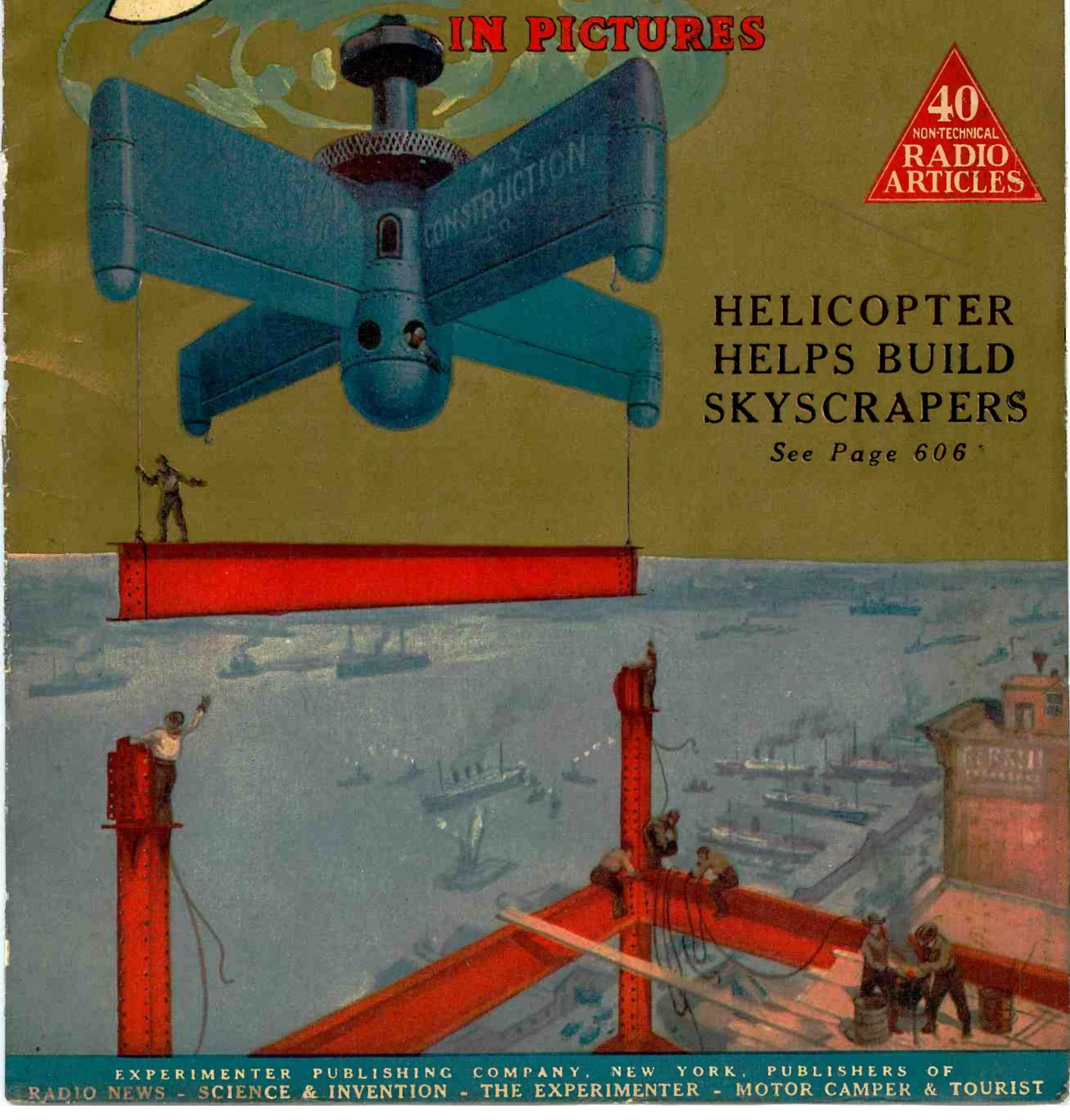
Science and Invention

IN PICTURES

40 NON-TECHNICAL RADIO ARTICLES



HELICOPTER HELPS BUILD SKYSCRAPERS

See Page 606

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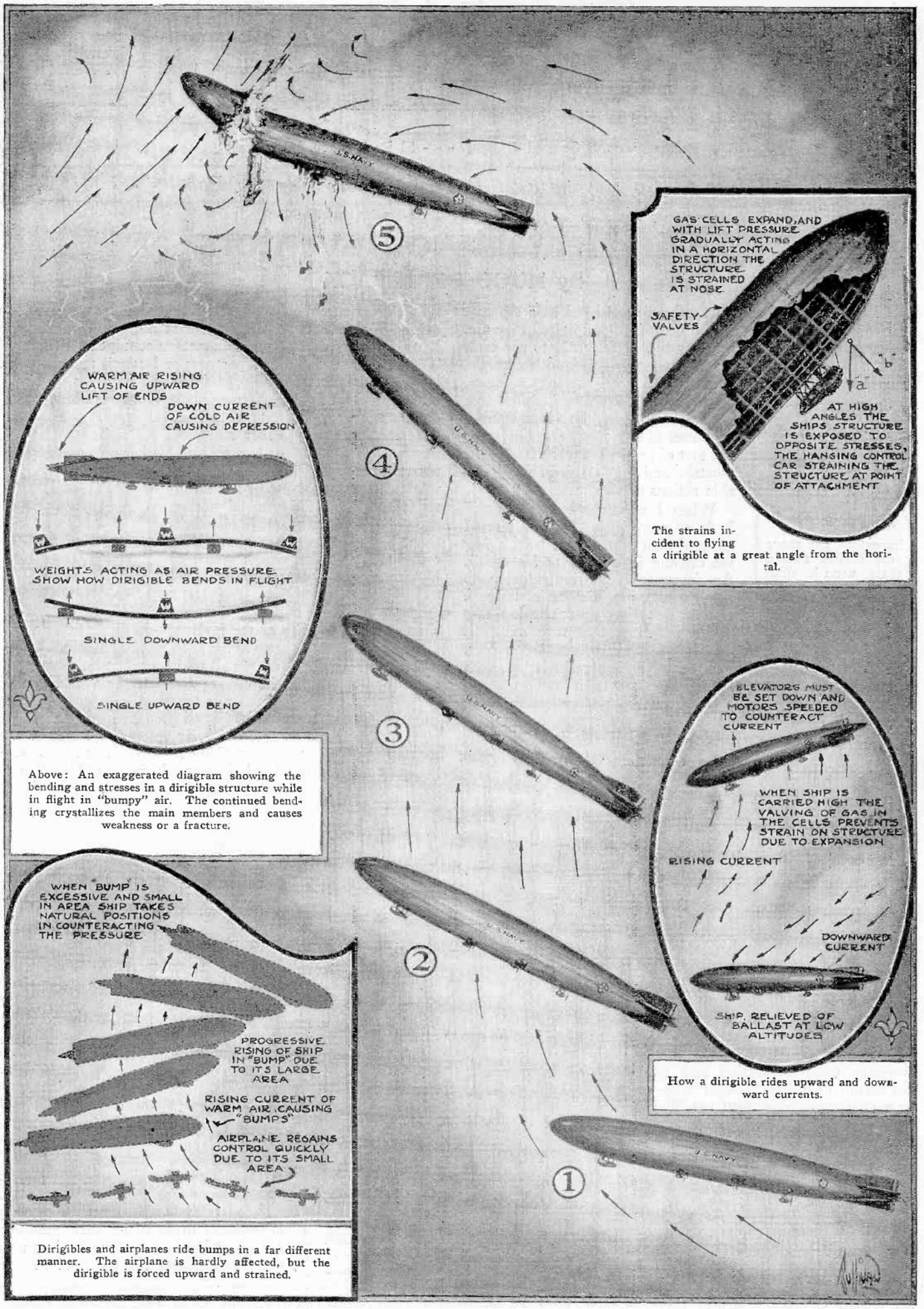
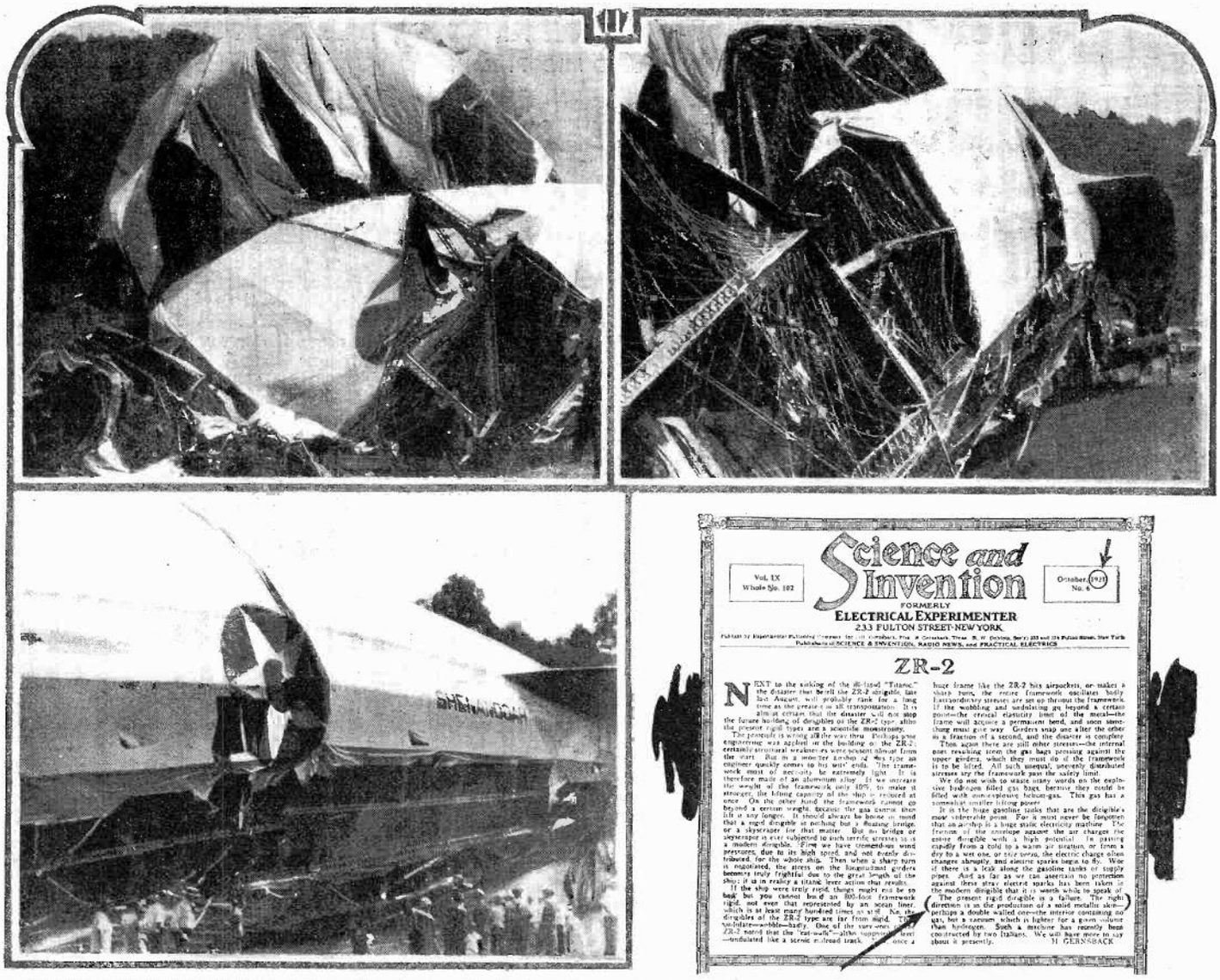


The strains incident to flying a dirigible at a great angle from the horital.

Above: An exaggerated diagram showing the bending and stresses in a dirigible structure while in flight in "bumpy" air. The continued bending crystallizes the main members and causes weakness or a fracture.

How a dirigible rides upward and downward currents.

Dirigibles and airplanes ride bumps in a far different manner. The airplane is hardly affected, but the dirigible is forced upward and strained.



SCIENCE AND INVENTION Magazine has always maintained that the present type of rigid airship is a failure. Note the horrible wreckage of the "Shenandoah" shown in the photographs and our prediction in the reproduction of an editorial published in 1921. Also note the mention of an all metal dirigible. Plans have recently been submitted to the United States Government for the construction of an all metal lighter-than-air ship.

The "Shenandoah" Versus the Elements

By WILLIAM P. SULLIVAN, Aeronautical Engineer.

SINCE man first began to sail the skies in rigid lighter-than-air craft, the problem of construction and control with regard to the elements has always been a matter of vast importance. Due to its enormous surface it is exposed to many and varying air currents that strain the rigid structure to its limits. These currents sometimes produce pressures totaling many tons and the structure must be designed not only to take these stresses in one direction but to distribute the many opposite and diagonal stresses throughout the entire length of the ship, much the same as an ocean liner distributes the buoyancy stresses of large waves.

The problems concerning the design of such a structure represent a vast amount of engineering analysis, theory and experience. First of all a dirigible to be efficient must be of large dimensions as the strength-weight ratio of the structure varies in proportion to its size. If one were to build a small dirigible, say of 250,000 cubic feet capacity, its efficiency as regards useful load carried would be considerably less than half the useful load of a dirigible of 500,000 cubic feet capacity. The buoyancy or lift of the confined gas would be exactly double that of the smaller one while on the other hand the structure would be considerably less than twice the weight. To offset this efficiency of useful load carried, the larger ship exposes considerably more area along a greater length to the various air currents and due to its greater weight and area, the stresses become enormous in all directions.

For example in flying a rigid airship in "rough" air the structure tends to bend with the air current and as it travels forward, it follows a snake-like course. It is a known fact that in some instances the keel corridor which is normally a straight pathway, has been completely hidden from view at distances ranging from fifty to seventy-five feet, in much the same manner as one might view the aisles of a railroad train while traveling over a winding section of rail.

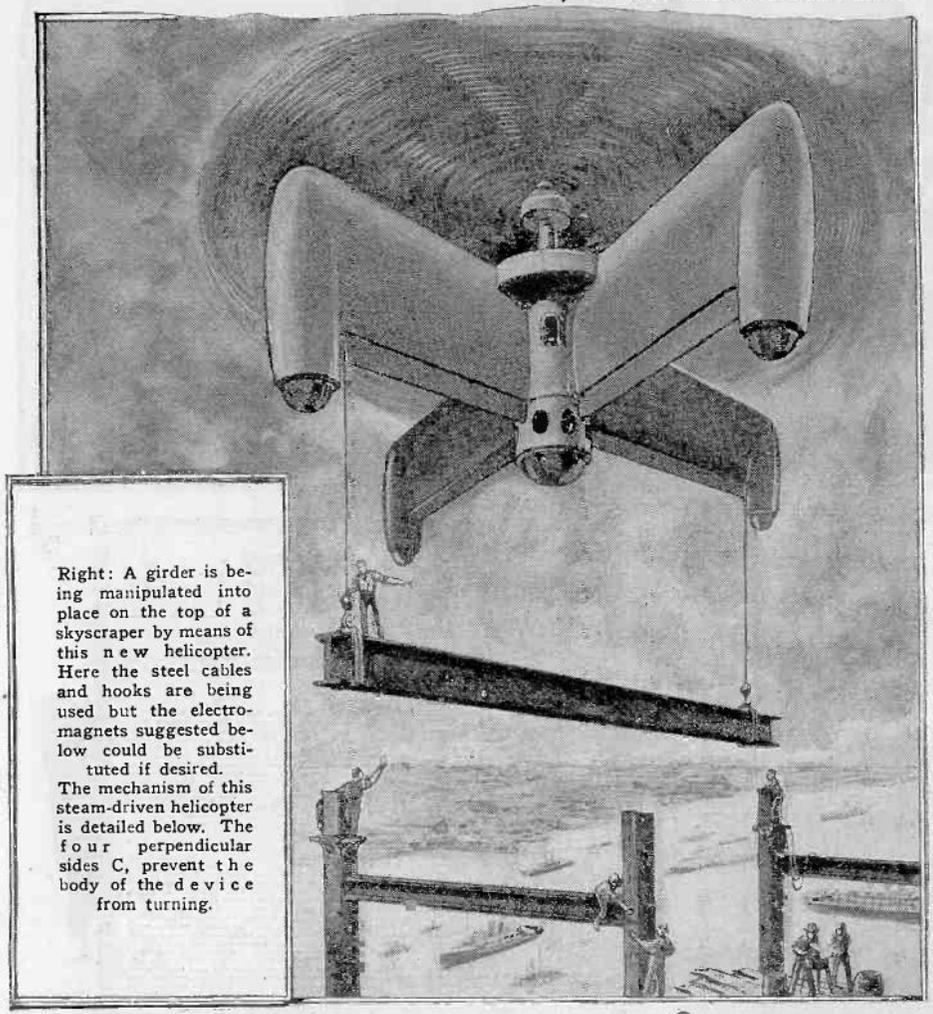
It is this constant twisting and bending of the metal lattice and wire structure that bring about fatigue and crystallization, resulting in the failure of important members. This can be overcome only with proper design by experienced engineers on metal construction, especially in the uses of the modern alloys.

The metal which is used mostly in the construction of frames and girders of dirigibles is called duralumin, an aluminum alloy. This metal is very peculiar and today it still has its unknown qualities. It is highly favored in aeronautical construction because of its high tensile strength and low weight, comparing favorably in tensile strength to that of low carbon steel and weighing slightly more than aluminum. It is used mostly where rigidity and lightness is desired, but is seldom used in structural parts that require bending in manufacture, or take severe bending loads in use. This is avoided because of the fact that the metal is not ductile, crystallizes very rapidly and cannot be welded or heat-treated with the degree of safety and cost required in this type of construction.

(*Continued on page* 674)

Helicopter Helps Build Skyscrapers

By H. WINFIELD SECOR. E. E.

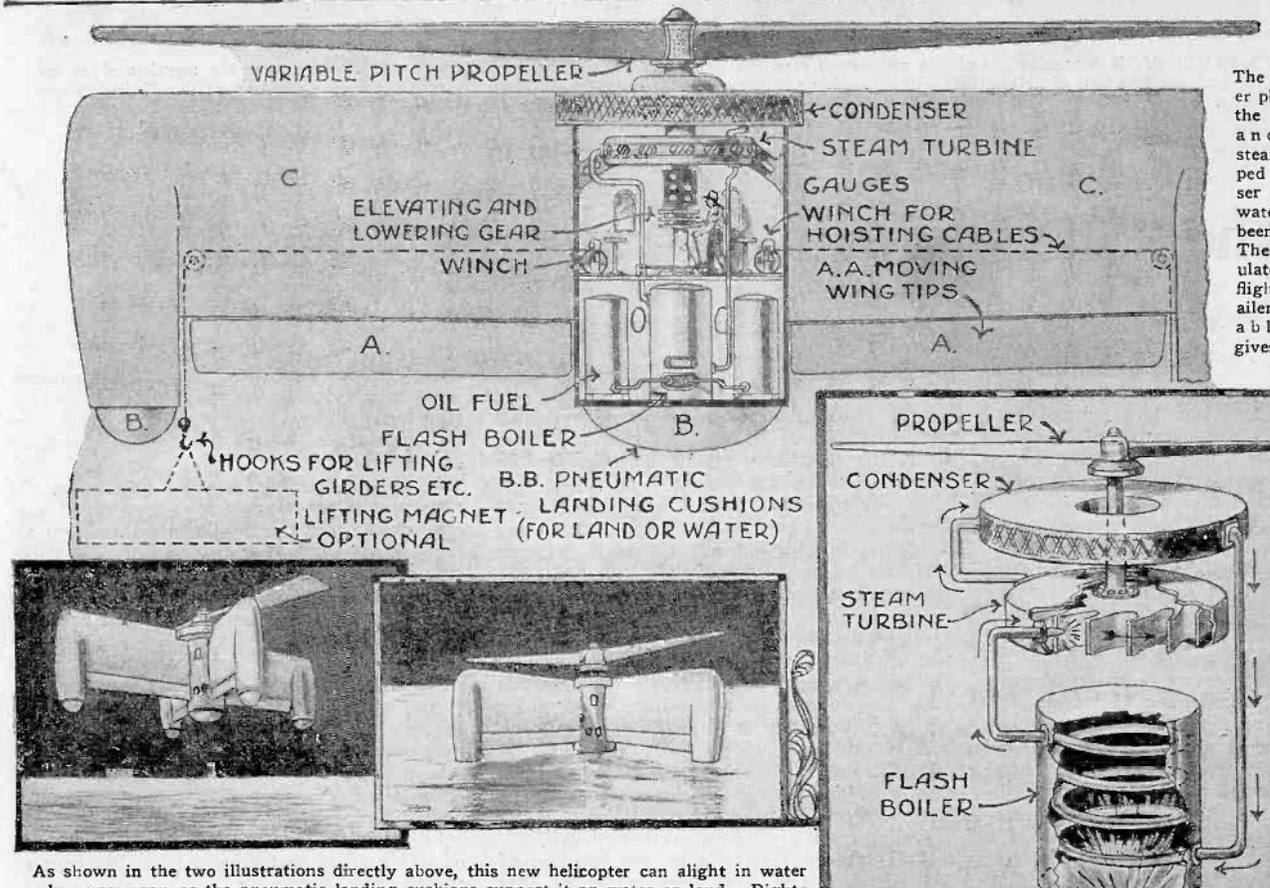


Right: A girder is being manipulated into place on the top of a skyscraper by means of this new helicopter. Here the steel cables and hooks are being used but the electro-magnets suggested below could be substituted if desired. The mechanism of this steam-driven helicopter is detailed below. The four perpendicular sides C, prevent the body of the device from turning.

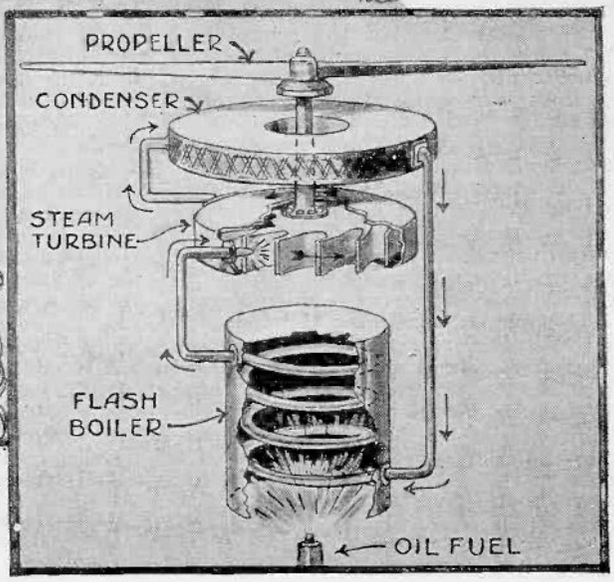
IN a recent issue of a German publication, Dr. Rudolf Wagner of Hamburg proposed a novel scheme that would enable sufferers from various diseases to obtain the benefits of high altitudes, quickly, easily and comparatively cheaply. The idea in main was to utilize a newly developed type of steam-driven helicopter that would be capable of sustained flights of many hours' duration. His particular type of vertical rising flying machine that is at the same time capable of hovering or of horizontal flight presents many novel features which he explained to the writer.

A much more novel application and one that seems to be very practical is suggested herewith and illustrated at the immediate left. The helicopter, equipped with its regular power system and with its pneumatic landing devices, can be equipped with steel cables and hooks for handling long heavy girders used in the construction of skyscrapers. Thus, cranes and their attendant supports would be eliminated and the work could be carried forward much faster. This newly designed machine, it is said, can be very easily manipulated and steered into any desired position. Its altitude can be maintained with little or no trouble and these faculties make it most adaptable to building work of this nature.

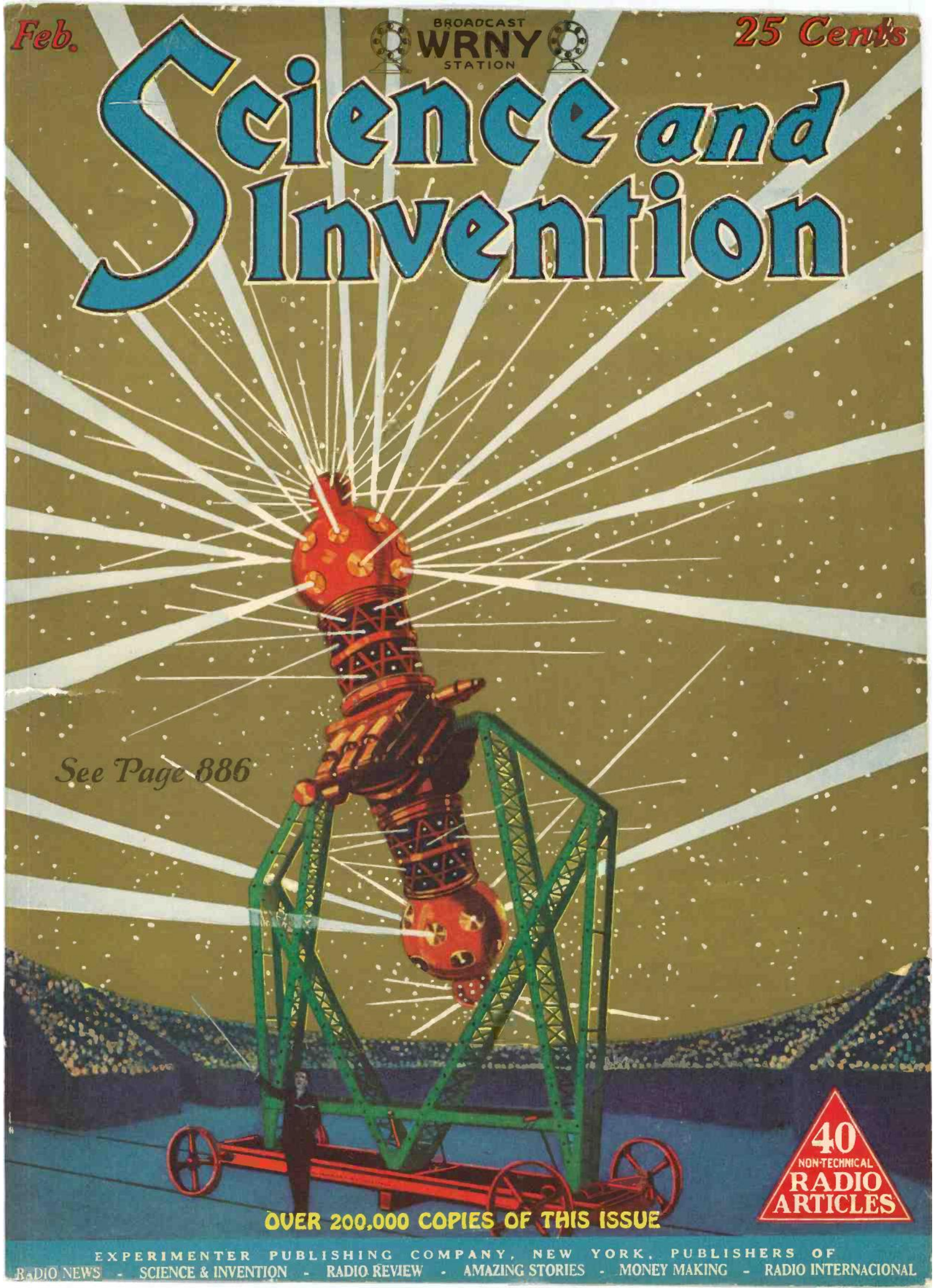
If, instead of girders, it is desired to handle smaller iron or steel parts, electro-magnets could be hung from the hooks on the ends of the cables and used to pick up the parts. The helicopter could then rise and fly to its destination and there deposit the material. It is quite possible that with proper designing, these electro-magnets could also be used for handling the steel girders, doing away with the necessity of suspending the beams by cables.



The helicopter's power plant is located in the central portion and consists of a steam turbine equipped with a condenser for saving the water after it has been used as steam. The device is manipulated in horizontal flight by the movable ailerons A. A variable pitch propeller gives different speeds.



As shown in the two illustrations directly above, this new helicopter can alight in water when necessary, as the pneumatic landing cushions support it on water or land. Right: Details of power plant simplified.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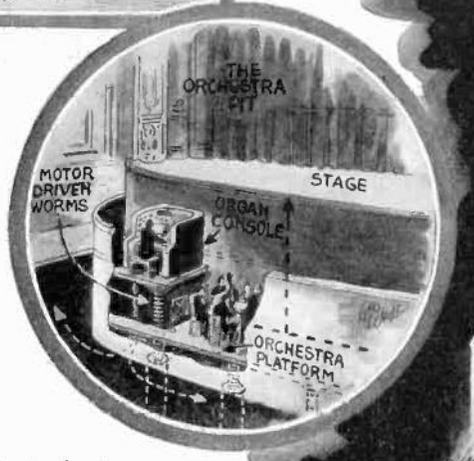
World's Finest Theatre

Eighteen Million Dollar Movie

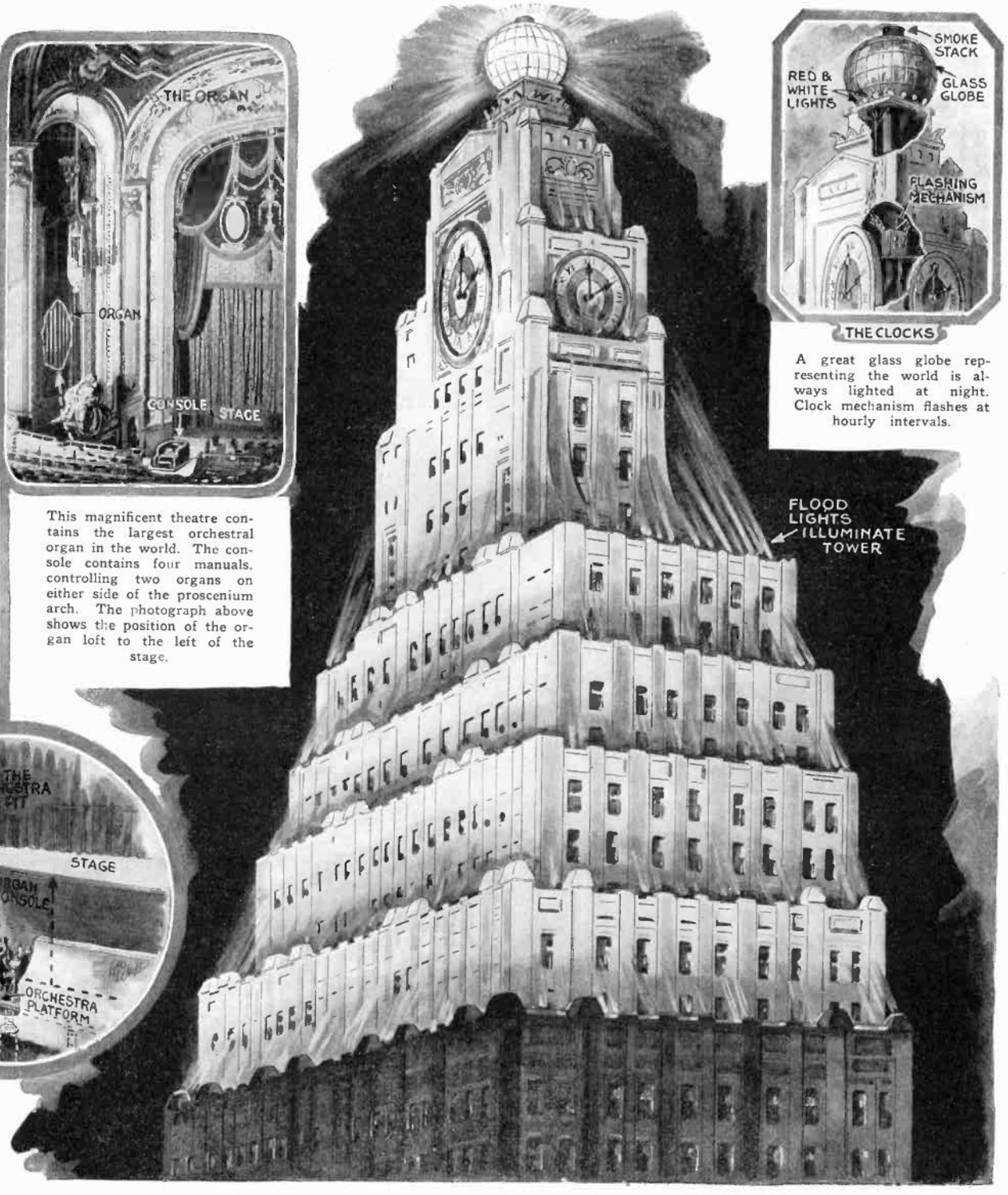
This magnificent theatre contains the largest orchestral organ in the world. The console contains four manuals, controlling two organs on either side of the proscenium arch. The photograph above shows the position of the organ loft to the left of the stage.



The appearance of Times Square in New York City has been completely changed in the past sixth months by the erection of an office and theatre building on Broadway from Forty-third to Forty-fourth streets. The Famous Players-Lasky Corporation purchased the old Putnam Building site at Times Square and proceeded to break all construction records by completing a thirty-five story office building in twelve months from the time of breaking ground. The Paramount Theatre, which forms the nucleus of this immense structure, is called the world's finest theatre. It contains all the latest developments in theatre art and science. The orchestra platform and organ console are placed on electrical elevators, so that they may be raised and lowered individually, as shown in the circle at the right.

THE CLOCKS

A great glass globe representing the world is always lighted at night. Clock mechanism flashes at hourly intervals.



Opens in New York City

Theatre Seats Thirty-nine Hundred

THE large wash drawing covering the greater portion of this page shows the details of construction of the auditorium and lobby of the new theatre. The grand lobby is one of the most impressive features of the ensemble. It is said to compare favorably with any of the European masterpieces of theatrical architecture. The lobby is approximately 144 feet long, and is paved throughout with marble tiles. The first twenty feet of the side walls are composed of marble obtained from a mine in Italy, opened after many years of inactivity for the special purpose of decorating this beautiful building. An interesting innovation for the convenience of patrons is illustrated in the circle above. A very complete electrical indicating system is arranged, so that ushers in various parts of the house may indicate seat vacancies by a signal board near the stairway in the main lobby. The chief usher, by referring to this central board, may tell just how many vacancies there are and their exact location.

IMMEDIATELY under the music room, indicated in the drawing above, is a marble archway, opening into the "Hall of Nations." In a large panel at the far side of this hall are imbedded stones representative of a number of foreign nations. These stones were presented in many cases by high officials of the governments of their native countries. In the music room, which is in the form of a balcony above the archway shown in the insert, artists perform continuously for the entertainment of patrons standing in the lobby and seated in various portions of the lobby promenade. It is interesting to note that elevators are provided for service to all floors of this theatre, running all the way up to the rotunda promenade, which is at about the tenth floor.

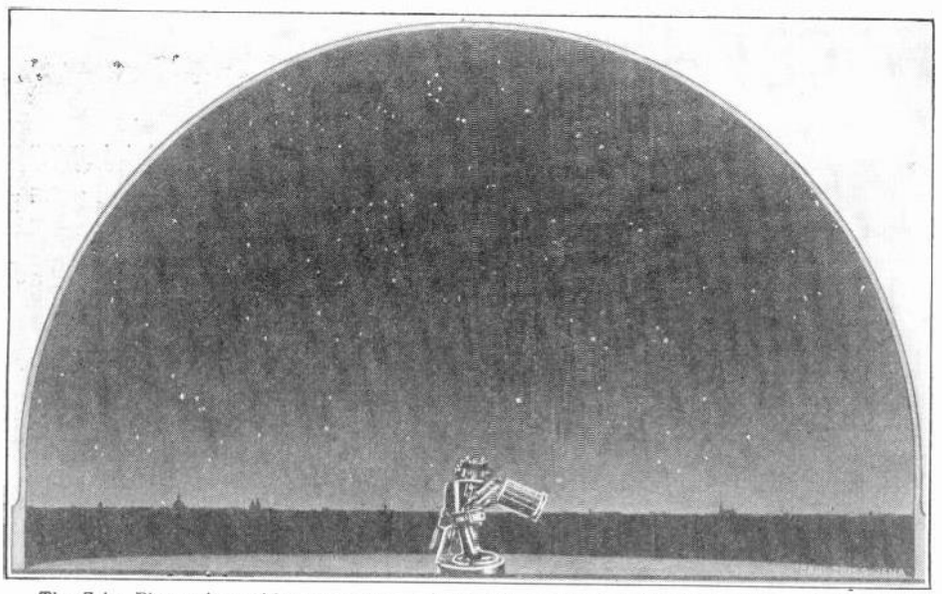
THE HALL OF NATIONS

THE BROADWAY ENTRANCE

THE auditorium of the Paramount Theatre is treated in the French Renaissance spirit, and the color scheme is ivory, rose and turquoise. The ornamentation has been particularly studied for scale, so as to be proportionate to the size of the auditorium and, although the auditorium is over 10 floors in height, the architects have achieved an intimate effect. The result is that the theatre is truly one of the sights of New York. The height from the orchestra level to the dome of the rotunda is about 140 feet, quite sufficient to make it possible to place a 10-story office building within the space occupied by the auditorium. The theatre is completely equipped with the finest of stage and lighting mechanisms, and effects may be obtained which are beyond the ambitions of most theatres. The visitor may obtain a magnificent view of the interior of the theatre from the rotunda promenade, which surrounds the dome vault, 10 stories above the floor of the theatre. The cooling system is graphically represented in the drawing above, which also indicates many of the details of construction far too numerous to list in the text of this article.

Artificial Sky

The New Zeiss

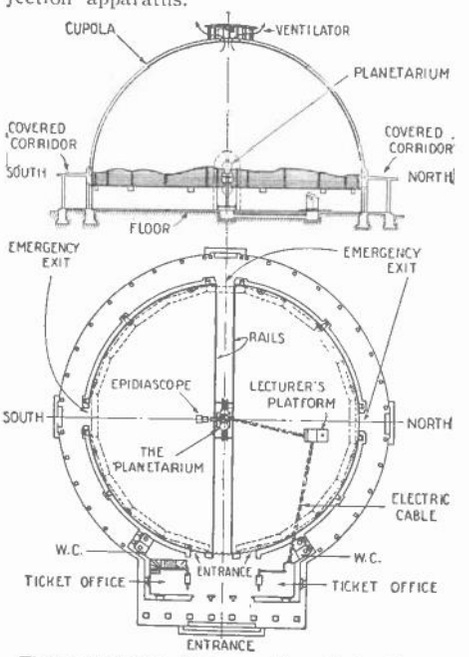


The Zeiss Planetarium with cupola nearly eighty feet in diameter, the inner surface of which is supposed to represent the vault of the heavens. This hemi-spherical surface is the screen on which the complicated projection apparatus in the center projects representations of the celestial bodies, stars, planets and moon, so that one feels as if they were out in the air under a brilliant night sky.

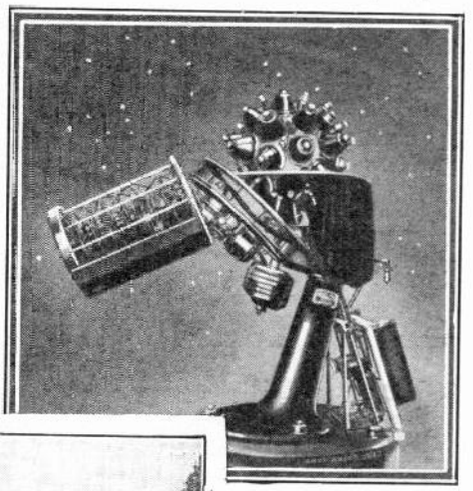
BEFORE the World War the director of the German museum in Munich, M. de Miller, asked the Zeiss firm at Jena to construct for the museum a planetarium, which would make possible the demonstration of the course of the planets before a large number of spectators at once. Its hitherto unattained perfection is due to the technician of the firm W. Bauersfeld. The idea of representing the celestial bodies by little spheres was abandoned and optical projections were substituted. How to get the motions by projection was an extremely complicated problem.

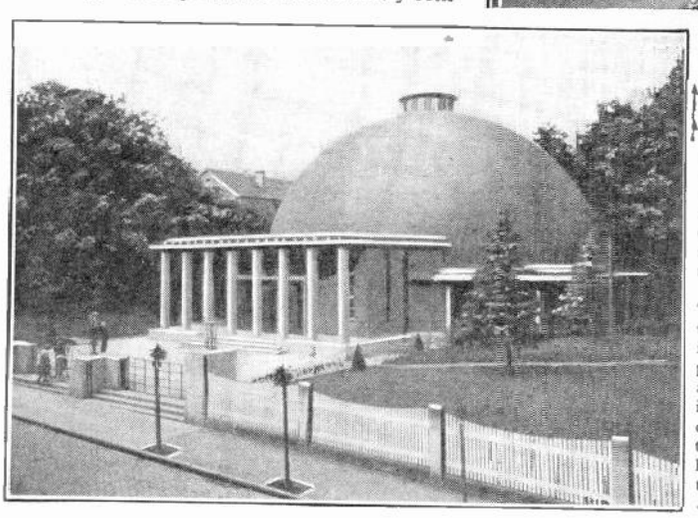
The Planetarium constructed by the Zeiss concern makes it possible to show astronomical phenomena of such diversity that to do it mechanically has hitherto appeared to be an absolute impossibility. The ingenious idea developed in this Planetarium is due to one of the technical engineers of this establishment, W. Bauersfeld; to him this progress in instructive mechanics is due. Mr. W. Bauersfeld completely puts aside the system of representing celestial bodies by little balls moved by any kind of mechanism. He, therefore, made the substitution alluded to, and this was productive of a high degree of simplicity. It centered all the apparatus in a small space, because, optical projection being used, it was simply a question of constructing and supporting and giving proper motion to a set of magic lanterns or stereopticons, as we may term them. But while on the face of it, this seems very simple, and while it does dispense with very clumsy mechanism of the old type, the construction of the apparatus presented an extremely complicated problem. Scientific knowledge and technical construction were intermingled in a way that only a house of the grade of Carl Zeiss at Jena could cope with.

The spectator goes into a cupola twenty-five meters or about eighty feet in diameter. The whole interior surface is white. The horizon of the place is traced upon the surface. Several rows of chairs surround the projection apparatus in the corner of the cupola. At first sight the projection apparatus resembles a pair of opera glasses, but looking at it more closely one sees that the objective or projection lens is replaced by thirty-one little projection apparatus of great precision, each of which projects a definite portion of the celestial sphere upon an area of the hemispherical wall. As a sort of counterpoise and covered by a glass shade, there is a cylinder containing the different mechanisms for projecting the sun, the moon and the planets; the invisible planets such as Uranus and Neptune, as well as the moons of Jupiter and Saturn are not represented. The instruments embody axes, one a polar axis and the other the axis of the ecliptic for the planets, the moon and the sun. There are two electric motors. The audience first sees the fixed stars come out in all their splendor. The illusion is so complete that we seem to be looking into the infinite depths of the sky. Four thousand five hundred stars are shown. After a while the names of the different constellations are also projected. This requires a second projection apparatus.



The upper figure gives a section of the planetarium, while below is shown its plan. The great size of the installation can be appreciated when the entrance shown on the plan which is a large classic columnar porch, is contrasted with the great circular building behind it.





Above is shown a perspective view of the extremely complicated projection apparatus. It has to take care of the planets in their motion each with its own individual path and speed, of the stars all having the same motion, and not the motions of the moon and of its different phases. This view gives an idea of the magnitude of the building. The impressive approach with an esplanade and flight of steps leading into a porch with a row of columns on the front and the beautiful hemisphere behind it makes it a most attractive piece of architecture.

And now the celestial sphere begins to turn and the phenomena of a winter night appears, with the rising and setting of some of the constellations or the paths of others around the pole. Then comes daylight, but which, while showing the sun, does not obscure or put out of sight the planets. Then comes the moon, which pursues its path and shows all its phases from the crescent to the full moon. Last of all come the planets. Mercury, the nearest to the sun, follows its orbit rapidly; Venus appears moving more slowly; Mars moves still more slowly, but Saturn and its ring is yet slower. From five thousand years ago to five thousand years in the future the heavens can be shown for any given date. Three different speeds can be given to the apparatus, four and a half minutes, two minutes, or fifty seconds can represent a celestial day, or a whole year can be given in four and a half minutes down to a few seconds. The earth can be arrested on its axis, which holds the star stationary, while the moon and the planets continue to move. The relation of the rotation of the earth and the apparent motion of the stars is clearly brought out.

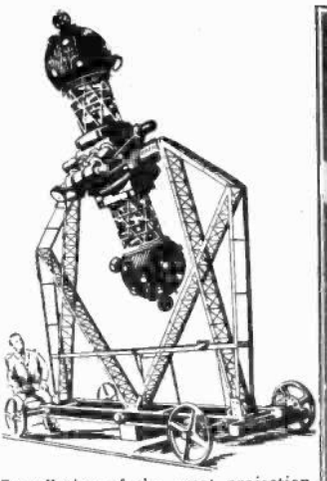
The apparatus comprises two similar parts, one above the other and below the horizontal axis. All the northern constellations are projected by the spherical portion of the upper division, while the cylindrical body, which carries the apparatus, projects

For Students

Planetarium in Jena

the moon and two planets, the lower part projects the meridional constellations and four planets. Besides this in A, is the apparatus projecting the names of the constellations, and in B are the projectors of the Milky Way. In C are contained not only the projection apparatus for planets of the solar system, but also the necessary apparatus for carrying out the movements of the sun, of the moon, and of the planets Mercury, Venus, Mars, Jupiter and Saturn. Finally in D are placed the apparatus for the projection of the representations of the great circles (equator, ecliptic and meridian) by luminous lines which are especially used when the Planetarium is employed for teaching. The whole thing is carried on a truck which moves on rails; the lighting is done by electricity.

The weight of the apparatus, including the frame and the car, is about four thousand pounds.



Installation of the great projection apparatus of the planetarium. The great frame has its dimensions made appreciable by the man seated near it. It is set and mounted so as to give the heavens the effect they would have if the sky was seen from the equator.

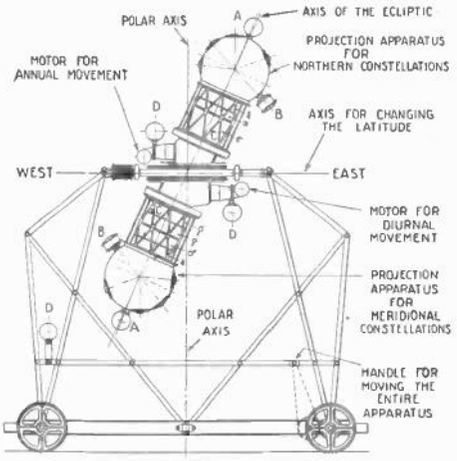
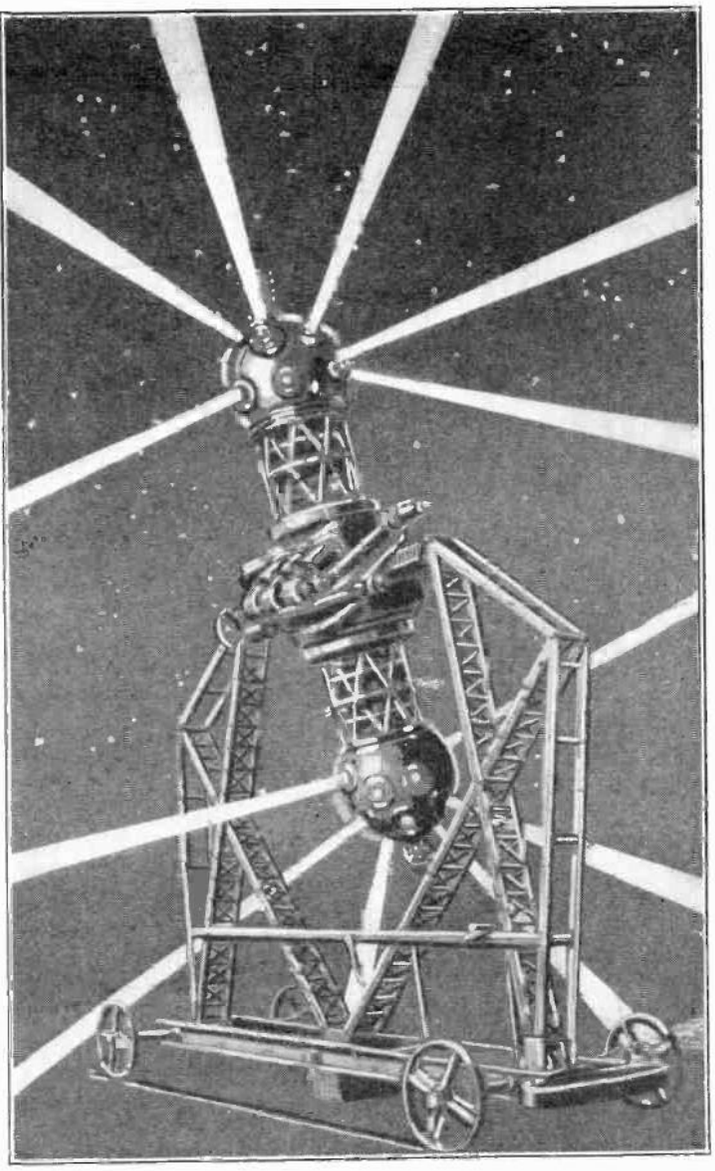


FIG. 1

Side view of the projection apparatus carried on its frame with its different parts named on the drawing. It is far more complicated than even this representation shows, as it has so many moving bodies to represent.

A better idea of the giant structure can be obtained from the photo given on the right. It would seem to be so bulky as to impair the illusion, but it must be remembered that it stands in the center of a giant dome.



Indian Fakir Lives On a Rope

NEXT after Egypt, India is the land which is celebrated for or rather plagued with the most beggars. A certain class of these do not reckon themselves among the beggars, but call themselves ascetics, hermits, monks, fakirs, or something else, which will have a more impressive effect upon the outer world. It is true that many of these are religious fanatics, who do penance upon themselves in various ways, partly for obtaining in their own conviction a holy state of existence; partly to win fame for themselves and attract the attention of tourists and by-passers and get alms from the same.

The man shown in the picture has for his specialty to lie stretched out upon a slack cord for days, for weeks or for years—yes, for all his life! This is an exhibition which in no other country than India could support a man's existence, but here it is a quite profitable way of obtaining a livelihood.

Regarded as a mere feat of balancing, it is certainly a very fine exhibition of the magician's art, which can excite our astonishment to the uttermost; but it is also a refined way of doing penance on yourself; a slight cord is certainly not a very comfortable bed, especially when one has to lie there for a long time. When the man is tired of lying on it, he suspends himself bodily as we see in the picture, that is to say, freely swaying with head and feet pressed against the bamboo poles.

Above is shown a Hindu fakir who spends much of his life on a single rope, an extraordinary feat of balancing. He seems to be contemplating a flower, perhaps a sacred lotus. A curious concession to which we may call modernity in the language of the theologians is the umbrella. The fakirs sometimes support themselves from the poles, and the insert gives the idea of how this can be done by straightening out the body and pressing in both directions with head and feet. Below is a cloth or rug with receptacles for coins thrown by spectators, for the fakirs like to make money.

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AERIAL FIRE FIGHTERS

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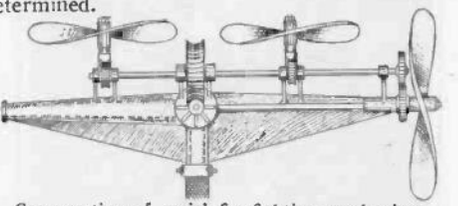
Fighting Flames from the Air

Pressure of a Stream of Water Carries the Hose to a Higher Elevation

By JOSEPH H. KRAUS

AN extremely ingenious device for fire-fighting particularly adaptable to the quelling of conflagrations occurring in some of the taller modern buildings has been invented by Edward P. Conlin of Girard, Ohio. It is well known that modern fire departments and fire-fighting devices are provided with engine-driven pumps producing a terrific pressure on the water forced through the hose and nozzle. Towers have also been made so as to direct the stream into the burning building with a greater degree of accuracy and with the assurance that the water will more directly reach the base of the flame. Mr. Conlin employs the pressure of the water to operate or energize two lifting propellers, the purpose of which is to carry the hose to heights unattainable with present apparatus, and he also has a propeller mounted at the back of the mechanism which will drive the fire-fighting appliance forward, in order to counteract the repellant action of the water.

Our artist has graphically portrayed how this type of an aerial fire-fighting mechanism could be employed in extinguishing a more or less serious conflagration in one of the modern skyscrapers. The peculiar V-shaped structures provided with the propellers are permitted to rise by their own power to a height greater than the floor level which the water is to reach. Even though the water may not pour out of the nozzle at a high pressure, it becomes evident from this drawing that the floor space could be completely drenched with water and the fire could in this manner be quenched. The question of properly directing the water must of course be taken into consideration. This could be accomplished by the aid of a grip provided with a suitable handle and surrounding the hose at its base. By twisting the hose, the entire mechanism at the top could likewise be made to swerve from side to side. The two web-like strengthening members are for the purpose of making the device more rigid and also assist in preventing oscillation of the appliance. The diagram below is a cross-section through the mechanism. The water coming up through the hose operates a water-wheel, which in turn is secured to a worm gear. The worm functions with another gear communicating with the two lifting propellers and also connecting with the propeller at the back for counteracting the repellant force of the water. The ratio of the gears and the design of the propeller must be experimentally determined.



Cross-section of aerial fire-fighting mechanism.

Above is an artist's conception of how the new aerial fire-fighting mechanisms will look when in operation. These are structures employing two lifting propellers and a driving propeller and are operated by pressure of water in the hose. They lift the hose to the desired height.

AmericanRadioHistory.Com

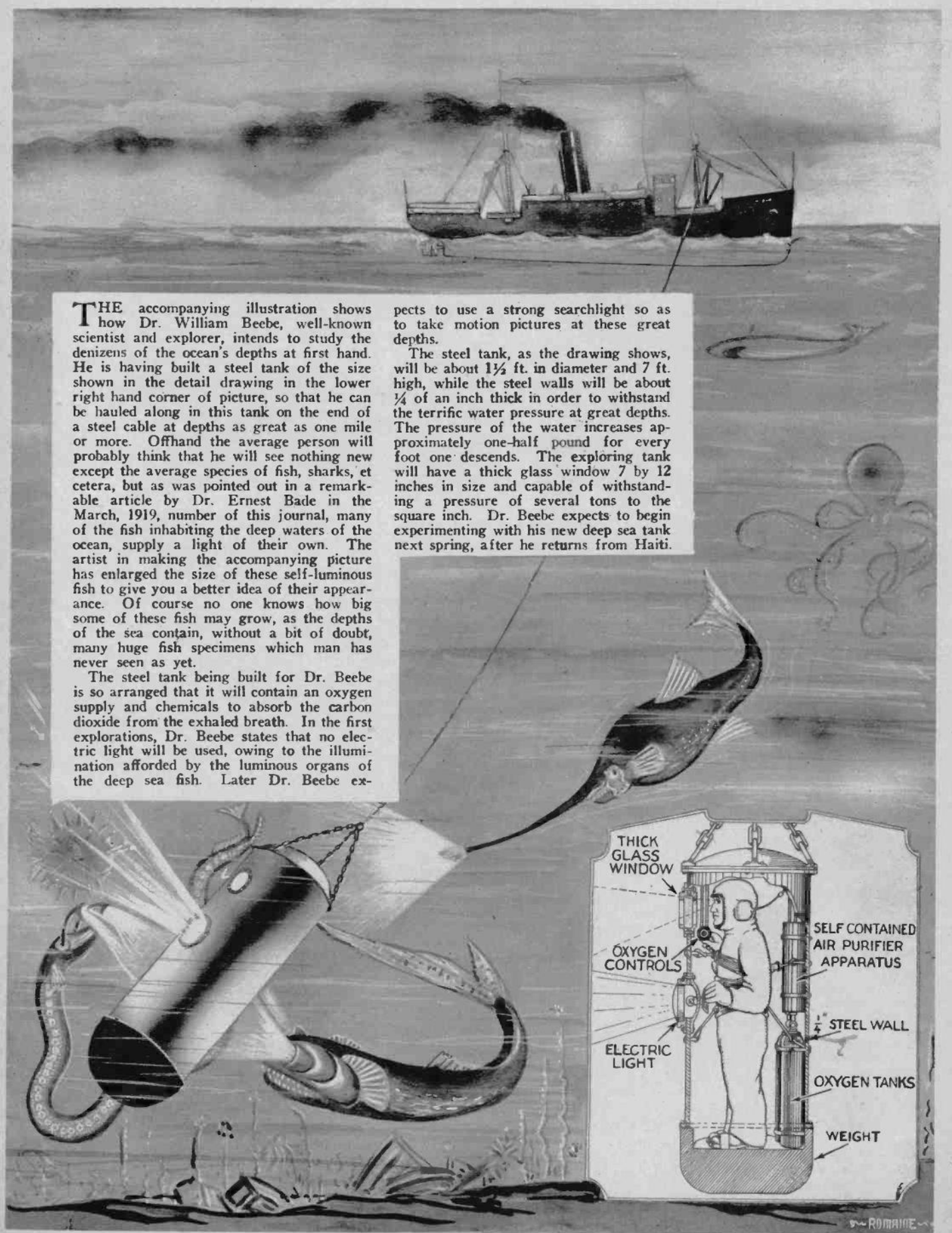
To Explore Ocean Depths in Steel Tank

Dr. William Beebe, the Famous Explorer, Is Having a Steel Tank Built to Study Deep Sea Fish

THE accompanying illustration shows how Dr. William Beebe, well-known scientist and explorer, intends to study the denizens of the ocean's depths at first hand. He is having built a steel tank of the size shown in the detail drawing in the lower right hand corner of picture, so that he can be hauled along in this tank on the end of a steel cable at depths as great as one mile or more. Offhand the average person will probably think that he will see nothing new except the average species of fish, sharks, et cetera, but as was pointed out in a remarkable article by Dr. Ernest Bade in the March, 1919, number of this journal, many of the fish inhabiting the deep waters of the ocean, supply a light of their own. The artist in making the accompanying picture has enlarged the size of these self-luminous fish to give you a better idea of their appearance. Of course no one knows how big some of these fish may grow, as the depths of the sea contain, without a bit of doubt, many huge fish specimens which man has never seen as yet.

The steel tank being built for Dr. Beebe is so arranged that it will contain an oxygen supply and chemicals to absorb the carbon dioxide from the exhaled breath. In the first explorations, Dr. Beebe states that no electric light will be used, owing to the illumination afforded by the luminous organs of the deep sea fish. Later Dr. Beebe expects to use a strong searchlight so as to take motion pictures at these great depths.

The steel tank, as the drawing shows, will be about 1½ ft. in diameter and 7 ft. high, while the steel walls will be about ¼ of an inch thick in order to withstand the terrific water pressure at great depths. The pressure of the water increases approximately one-half pound for every foot one descends. The exploring tank will have a thick glass window 7 by 12 inches in size and capable of withstanding a pressure of several tons to the square inch. Dr. Beebe expects to begin experimenting with his new deep sea tank next spring, after he returns from Haiti.



Scene showing self-luminous fish inhabiting ocean's depths and details of man-size exploring tank.

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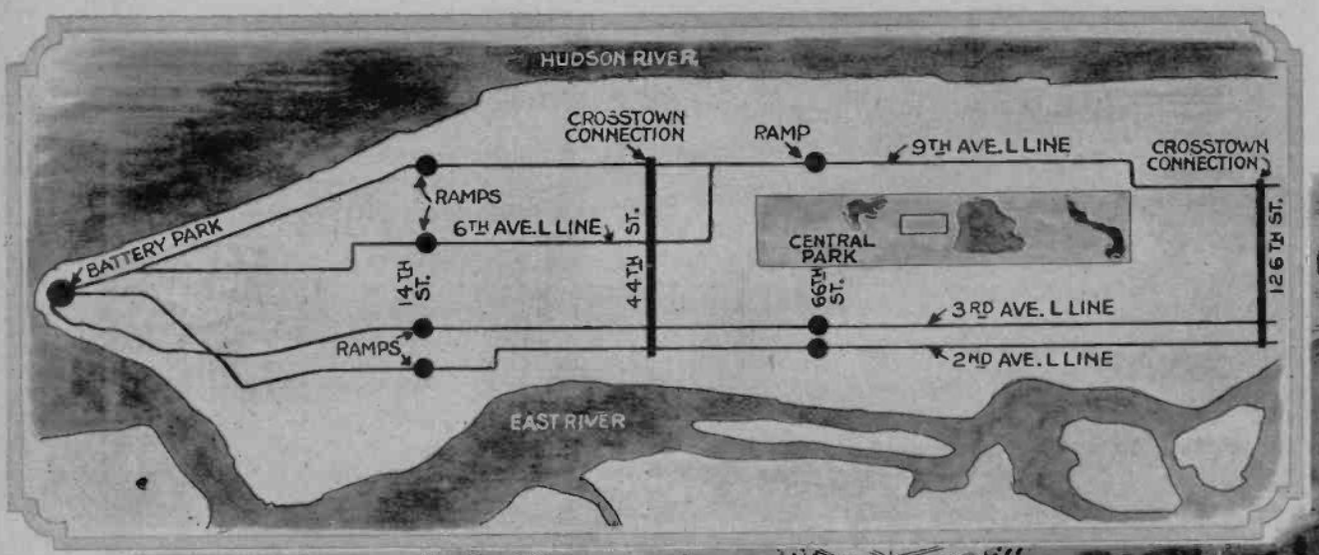
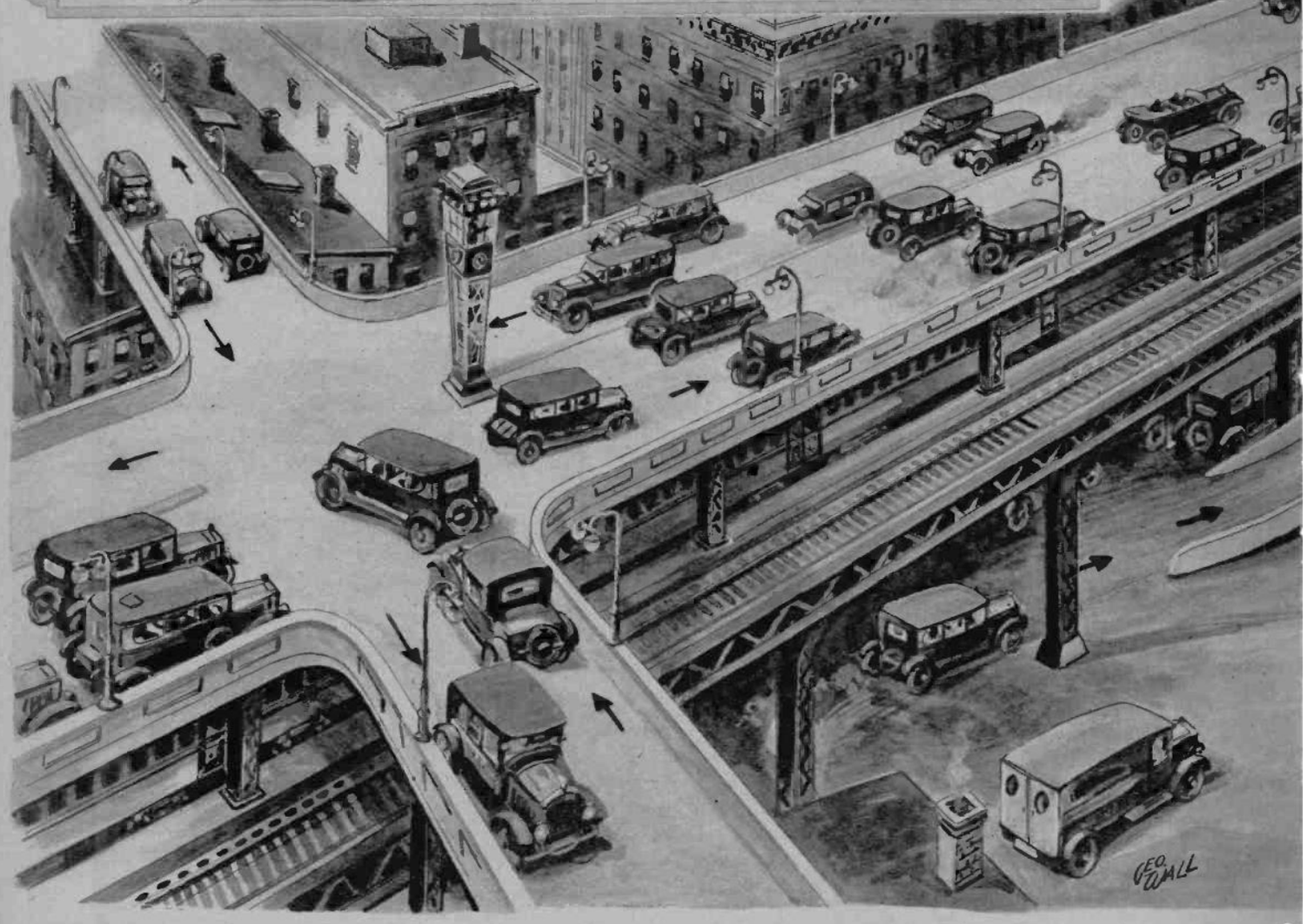
Solving Metropolitan

By HUGO
Member of American





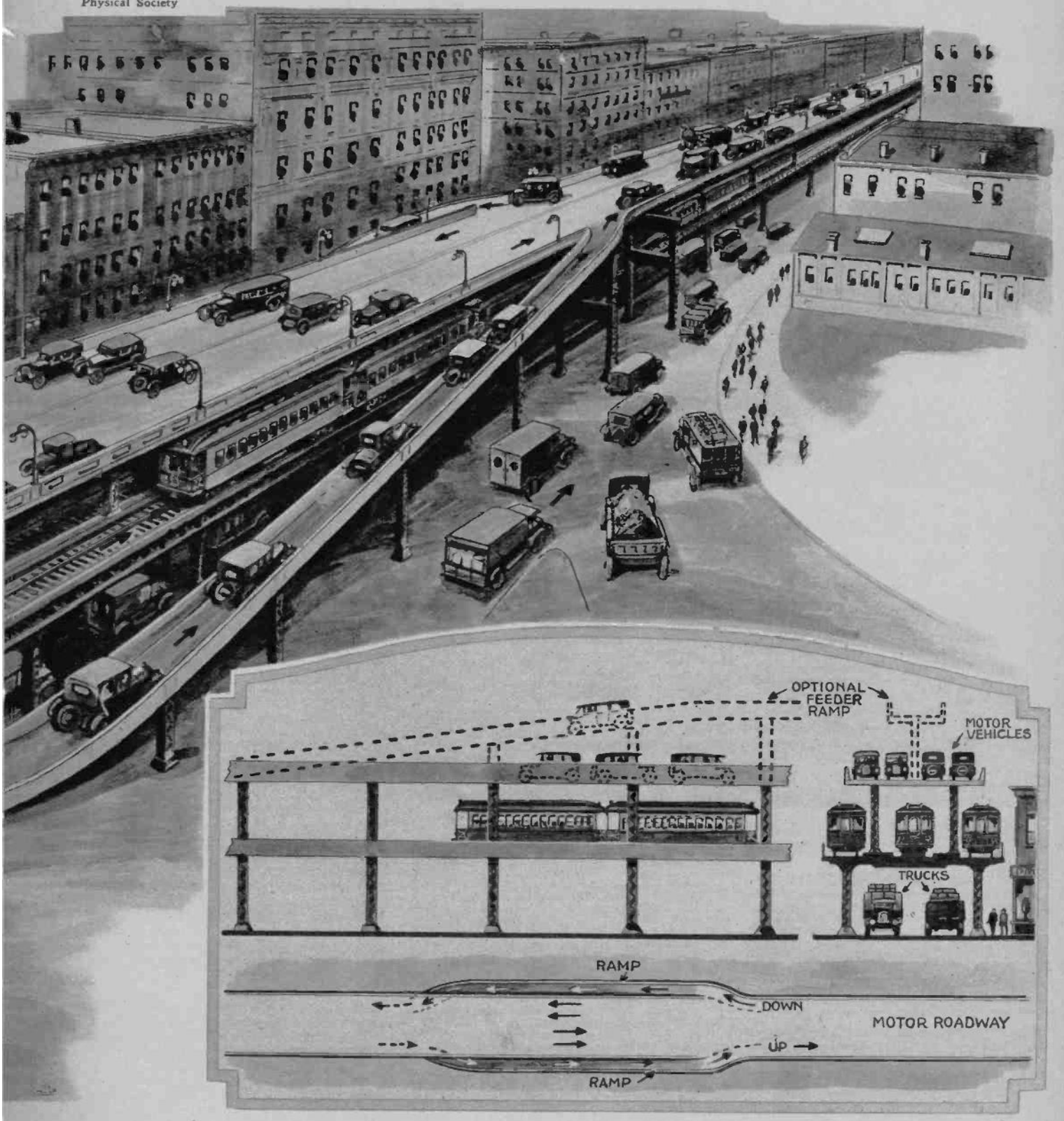
Herewith is shown the project of putting 50 per cent. of New York's automobiles on top of the elevated structures by constructing an automobile speedway on top of the existing four elevated structures. The view above shows the crosstown connection which connects the four elevated sections somewhere near 44th Street, as shown in the map. The author explains how to raise the funds for such a proposition.

THE student of traffic, particularly as it pertains to our large cities, must become impressed with the fact that if congestion gets much worse than it is at present, the very vehicles that are supposed to transport us and our freight rapidly will become obsolete, due to their staggering numbers. In our big cities this congestion has become so terrific that if you want to get anywhere within the concentrated traffic areas you can get there much more quickly on foot than by using any surface vehicle. Evidently the evil is progressing rather than abating, and what the conditions will be five years hence becomes one of the most interesting speculative topics of the day. It is reported that in Paris at the present time experiments are being made to park standing automobiles under the street by having an inclined ramp at certain corners, where automobiles can dive in and stand there out of the way. How many can thus be stored comfortably is not known.

The idea of double-decking streets is, of course, not new, having been suggested by many writers. It already has had a tryout

Traffic Congestion

GERNSBACK
Physical Society



The above shows the system of ramps, or approaches extending for almost two blocks parallelling the structure and curving underneath the elevated railroad to the street, to facilitate the automobile traffic, either coming or going, to the elevated speedway. The insert below shows cross section of the speedway, showing that four rows of automobiles can be accommodated. The other view shows the motor roadway looking from top.

recently in Chicago, where one such street is already in use.

The counterpart of the traffic congestion that exists in the City of New York probably cannot be found anywhere else on earth. This city, due to its geographical configuration, centers all the traffic within a comparatively small area. There are more vehicles passing a given point in the congested part of New York than any other traffic center on the face of the globe, and only those who have seen the terrific amount of congestion there have any idea of what is really going on.

It is, for instance, an everyday occurrence that at theatre time it will take some twenty or thirty minutes for an automobile to go the short distance of three blocks. The same distance can be covered on foot in less than two minutes, and most people, when they are late, always leave their cars and travel on foot, weather permitting.

New York City, however, offers a sort of solution for this evil, and the proposal which I make herewith seems to provide relief for at least fifty per cent of the auto-

(*Continued on page* 1057)

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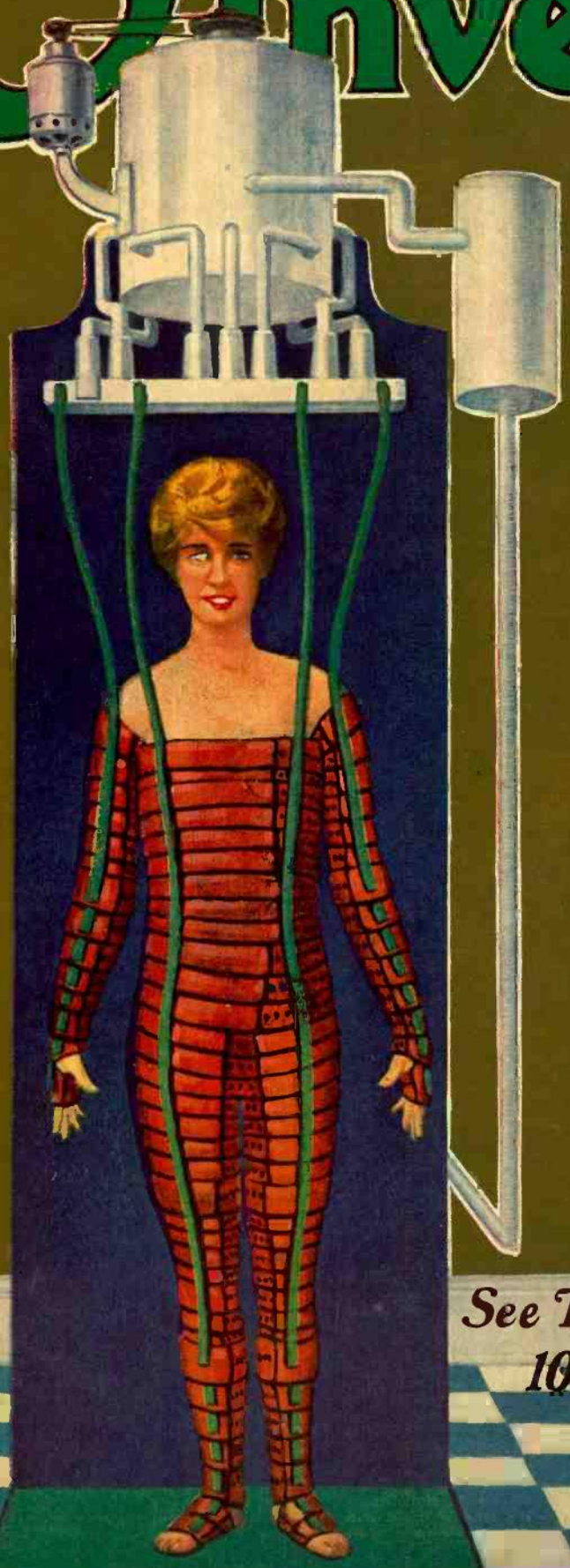

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See Page 1094

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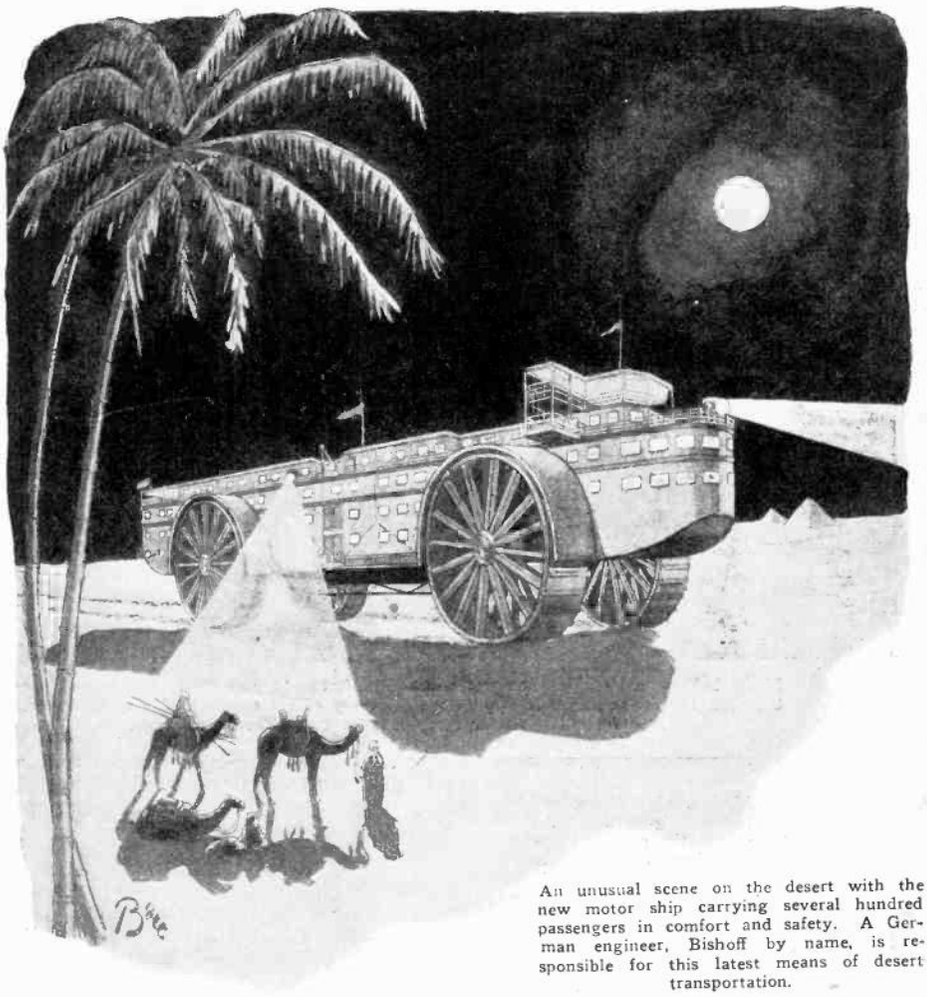
MOTOR SHIPS



An unusual scene on the desert with the new motor ship carrying several hundred passengers in comfort and safety. A German engineer, Bishoff by name, is responsible for this latest means of desert transportation.

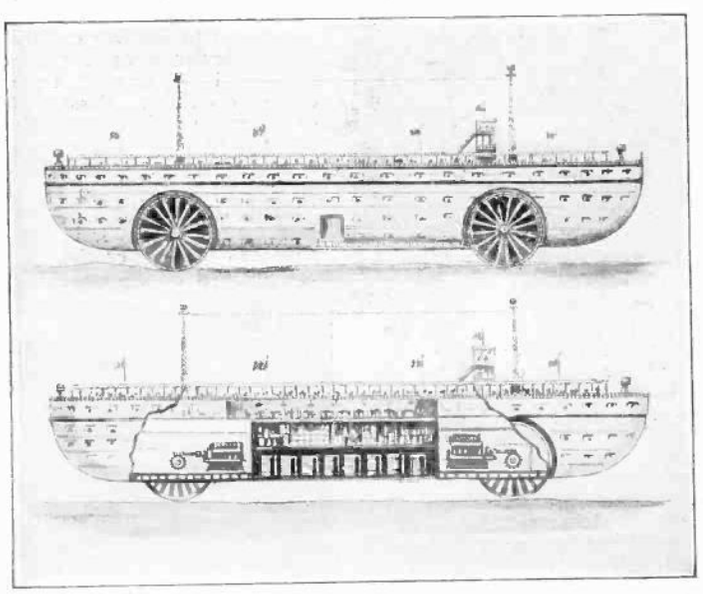
FOR æons people have traveled across the Sahara Desert on the back of a camel, the camel being a very important part of the setting for such a journey, owing to the fact that it can go for several days without a drink. The great problem in attempting to travel across the desert has been the lack of water and the terrific heat caused by the tropical sun beating down on the sand. In the past few years French engineers have succeeded in designing a suitable automobile for negotiating the desert routes, this automobile being illustrated in the picture on the opposite page, where we also see the famous camel taxi known as a Bussoura. The automobile, of which many are in use for desert travel today, represents one of the units of the French military transport service. The car is fitted with a tractor belt tread at the rear, this belt being driven by a gasoline engine. An extra large water cooling system is fitted to these engines. Referring to the Bussoura or camel taxi shown in the same photograph, this name comes from the tent-like basket or cabin fitted to the camel's back, and which provides protection against the hot desert sun for two passengers.

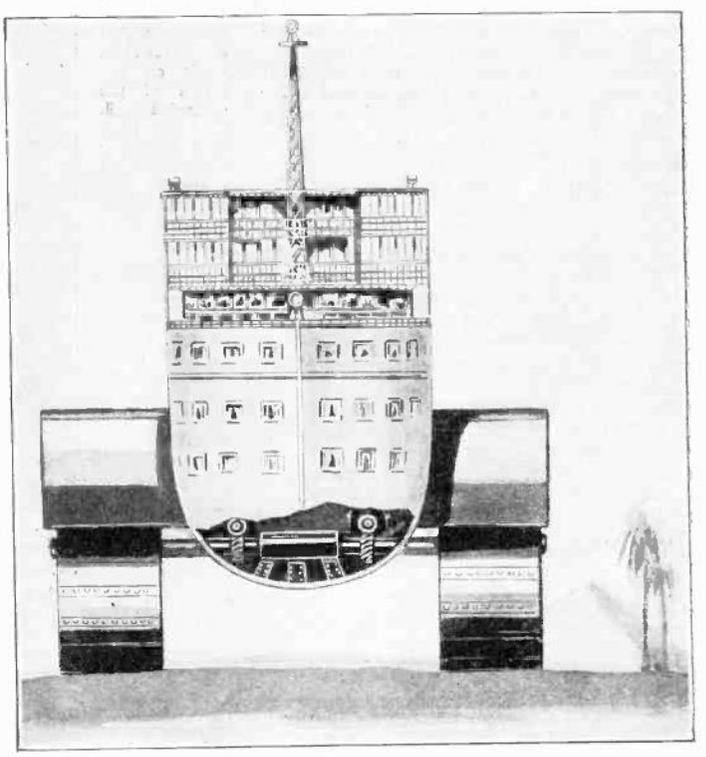
The feature which we wish to speak of here, however, is the new giant motor ship for desert transportation of passengers and freight, which is shown in the accompanying artist's picture, on its way across the desert at night. This strange land craft is the brainchild of a German inventor, one Johann Cristoph Bishoff, who is working out his ideas in conjunction with other engineers and with the cooperation of industrial interests. This future *ship of the desert* will have a capacity of 300 passengers and fifty tons or more of freight.

As the illustrations at the bottom of this page show, the craft greatly resembles an ocean liner mounted on huge wheels. Many of our readers will doubtless remember that back in July, 1917, during the World War, Mr. H. Gernsback published an article in this journal, then known as *The Electrical Experimenter*, entitled, "Old U. S. Battleships to the Front," as the cover of that issue of the magazine reproduced on the opposite page shows. Mr. Gernsback's idea at that time was that we should take some of our old battleships, cruisers, etc., steam them across the ocean under their own power, and then fit them out with the steel girder wheels as illustrated, so as to form huge battle tanks. It is quite possible that the idea published at that time provided the spark of genius behind the newly devised desert motor-ship. This ship of the desert will make twenty miles an hour and better under ordinary conditions, and a speed of at least ten miles an hour if the sand is soft and deep.

The end view of the new motor ship for desert transportation of passengers and freight, shown at the right, reveals how the huge gasoline engines drive the wide tread wheels by means of worm gears. ➤➤➤

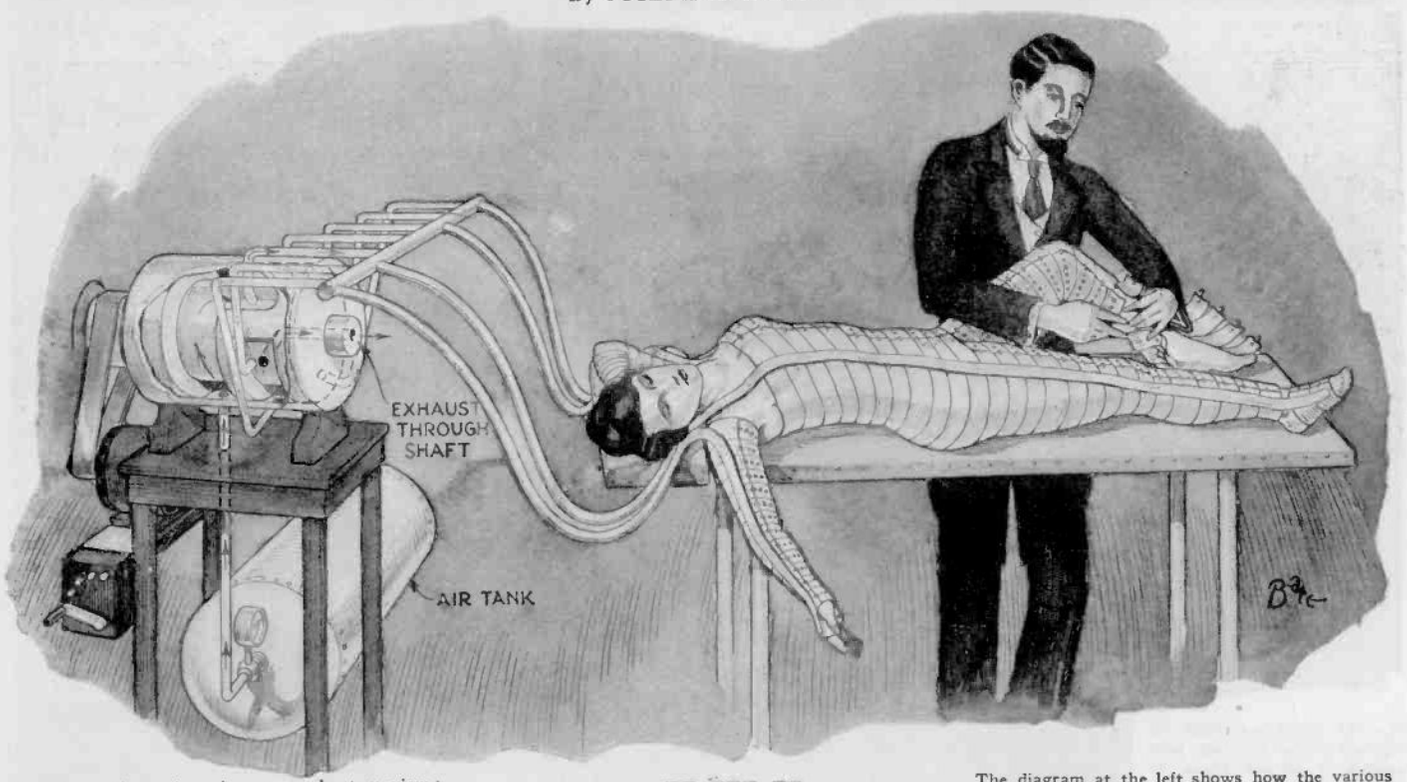
The picture below shows external side view as well as semi-sectional view of the new motor ship of the desert designed by a German engineer. The desert ship is 300 ft. long, 38 ft. in breadth, and stands 50 ft. high, the wheels being about 40 ft. in diameter. Capacity 300 persons and 50 tons freight.





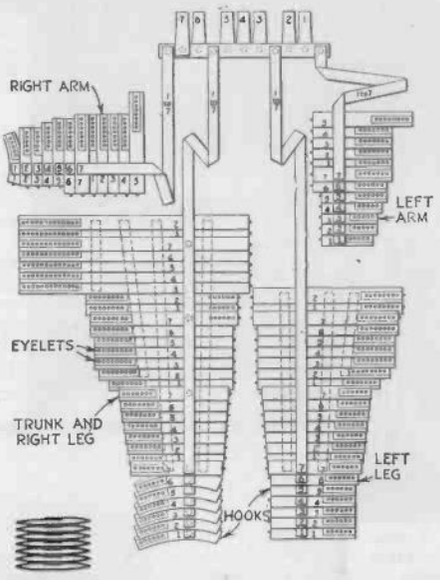
Pneumatic Suit Aids Heart

By JOSEPH H. KRAUS

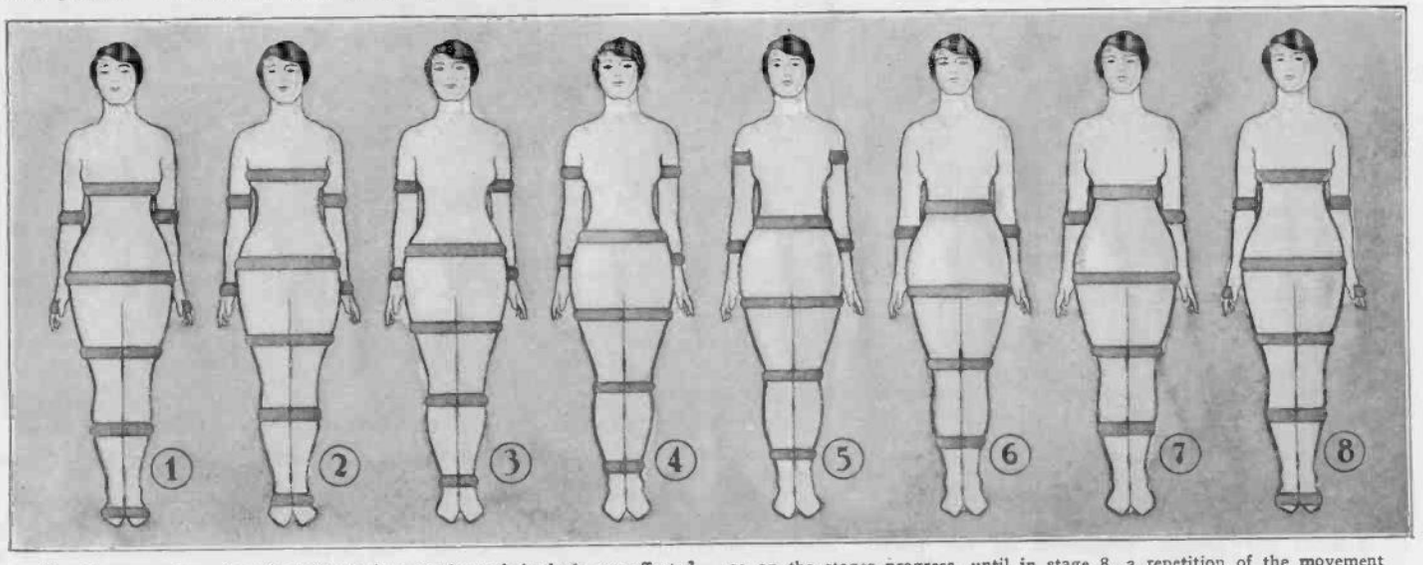


The above illustration gives us a phantom view through the mechanism which operates the sections of the pneumatic suit primarily intended to relieve the work of the heart.

IN the illustrations on this page we find a very clever therapeutic device primarily intended to assist in the circulation of the blood and also serving to massage the human body. The inventor, Joshua Rosett, of New York, believes that this type of pneumatic suit will provide relief to a certain extent for the work of the heart where such relief is necessary. This is accomplished by propelling the venous blood at the surface of the body from the limbs and from the trunk toward the heart. By the accompanying kneading of the muscles and tissues, the circulation of the deeper fluids of the body such as the blood in the inner veins and the lymph in the lymphatic spaces is consequently enhanced. Generally speaking the device consists of what may be considered a pneumatic suit or garment adapted to be applied to the trunk or limbs of a patient. This suit is made up of collapsible tubes to which air under pressure may be admitted in such a manner as to inflate the tubes one after the other in successive groups, so as to cause the garment to exert waves of pressure from the extremities of the limbs and from the lower portion of the trunk of the patient towards the region of the heart. The compressed air is admitted from an air tank to a distributor which respectively passes the air into any one group of seven tubes each in successive order. Each unit of the garment is represented by seven tubes evenly spaced so as to form distinct hose-units. For convenience in handling, the garment is so arranged that it may be quickly snapped around the body and the limbs. The tubes themselves are made of an air-tight textile fabric such as rubberized silk or cotton. Referring to the picture above, we see a patient having suit adjusted.



The diagram at the left shows how the various sections of the suit are tied together. Each band has seven tubes and the respective numbers are all inflated at the same time.

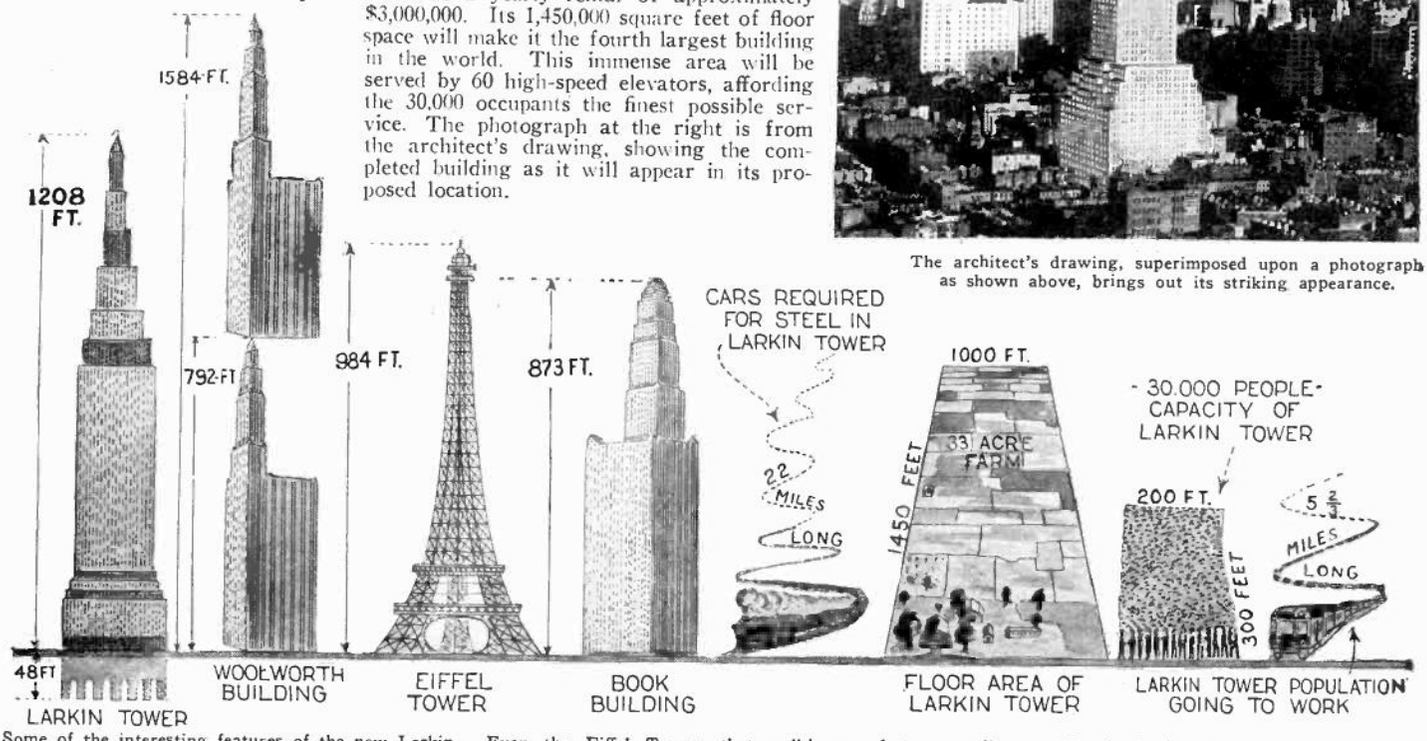


The diagrams above show how the various portions of the body are affected by the inflated bands. First the tubes indicated in Fig. 1 are inflated. Then the air passes out of these to enter the tubes as indicated in 2 and so on the stages progress, until in stage 8, a repetition of the movement started at 1 reoccurs. By passing the eye across the page quickly, one can see the wave-line motion which will be produced.

110-Story Uptown Skyscraper to Top New York's Skyline

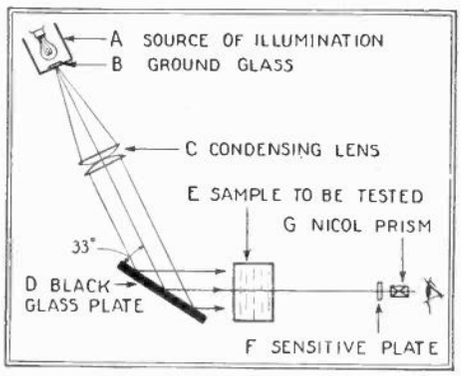
FOR a number of years, the Woolworth Building has enjoyed the distinction of being the tallest business structure in the world. But it has suffered a double eclipse in the past year, first when the Book Building in Detroit was announced with its height of 873 feet, and again when a real super-skyscraper was proposed in New York City. This latest project is peculiarly interesting, less because of its extreme height than because of its history. The fact is that the building was not specially designed to be taller than other buildings. The architects simply endeavored to provide the greatest amount of permanent light and air to the greatest possible proportion of floor area, with a surplus of elevator service. The projected building came naturally out of these conditions. The architectural aspect of the structure is featured by its severely simple lines, approaching an ideal of skyscraper construction. The building, called the Larkin Tower, will front 226 feet on the south side of 42nd Street, 300 feet west of 8th Avenue, and run through the block to a frontage of 250 feet on 41st Street. The height of the building from the ground to the base of the flagpole is to be 1208 feet. From a first cost of $22,500,000, the builders expect to realize a yearly rental of approximately $3,000,000. Its 1,450,000 square feet of floor space will make it the fourth largest building in the world. This immense area will be served by 60 high-speed elevators, affording the 30,000 occupants the finest possible service. The photograph at the right is from the architect's drawing, showing the completed building as it will appear in its proposed location.

The architect's drawing, superimposed upon a photograph as shown above, brings out its striking appearance.



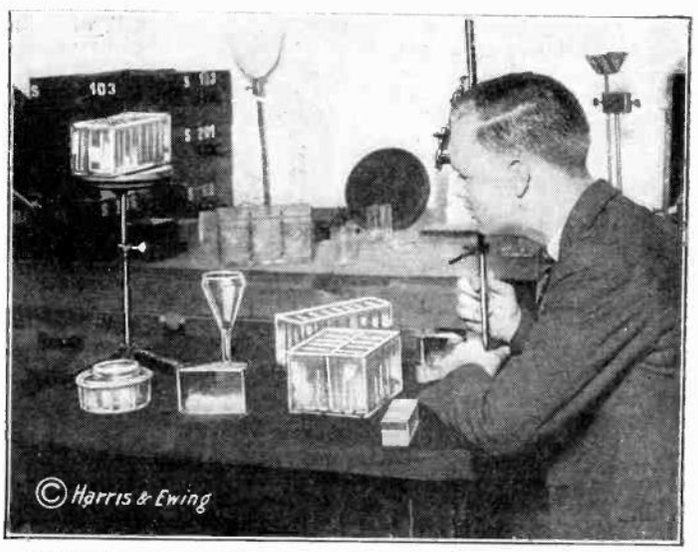
Some of the interesting features of the new Larkin Tower are illustrated in the drawings above. The famous Woolworth Building will be "just another skyscraper" after the uptown giant is completed. Even the Eiffel Tower, that well-known feature of the Paris skyline, will be dwarfed by comparison with the Tower's 1,208 feet of height. A new subway is being built under Eighth Avenue, which will run directly beside the new Tower. This should relieve the otherwise inevitable congestion which would result from the presence of a building of this character in this neighborhood.

Testing Glass Products for Strain



A schematic diagram of the apparatus used at the Bureau of Standards for testing samples of commercially produced glassware for strain.

A piece of suspected glass is placed in the beam of light between the polarizing plate (D) and the Nicol prism (G). Parts of the glass will seem colored differently than the original field. If well-annealed glass is examined, practically no change in color will be seen, and if a highly strained piece of glass is used, the colors in striations will be vivid. If the sensitive tint plate (F) is removed, and three differently strained pieces of glass are examined, the first (moderate strain) will appear brighter in certain areas, the second (no strain) will produce no change, and the third (high strain) will be very bright, or even colored in some places. This process has been applied commercially to the testing of glass products such as jars and bottles in industrial use.



The engineer shown in the photograph above is demonstrating the use of the Strain Detector in testing storage battery cells.

April

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TO SAVE TOWER of PISA

See Page 1078

NEWBERRY -24-

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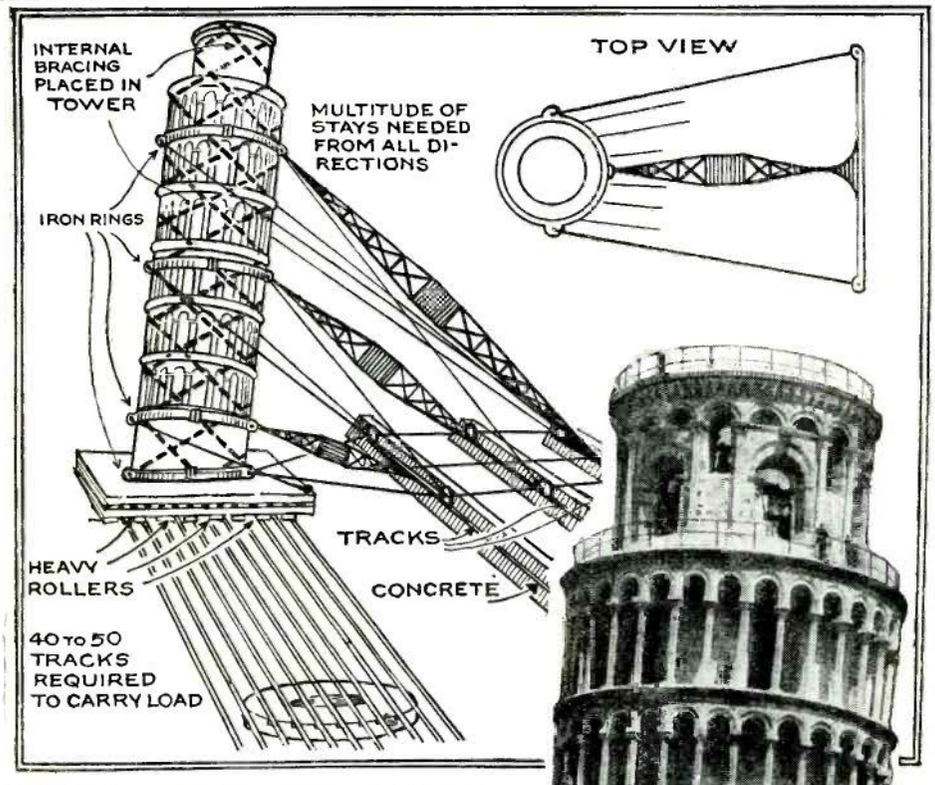
To Save

Modern Engineering



The author's scheme for suitably supporting the leaning tower of Pisa with a multiplicity of arms or braces is shown above. When the tower has been suitably supported and shored up on a platform placed on rollers, which in turn rest on a series of rails, it can be readily moved to a new foundation.

ONE of Italy's architectural wonders, the Tower of Pisa, is doomed to fall some day unless steps are taken to prevent it from leaning much further than it does now.

Pisa's tower was planned by a native architect, Bonanno, a famous Pisan architect of the Twelfth Century, some 753 years ago. While Bonanno was an excellent architect, he evidently must have been somewhat careless on his foundations. Instead of investigating the site upon which the tower was to be built, he only went down into the swampy soil a few feet, and then started to build. As a matter of fact, the foundation for the tower was only ten feet, which certainly was not sufficient, particularly in a swampy soil for a tower some 179 feet high and 51 feet 8 inches in diameter.

As soon as Bonanno had gotten some 40 feet up with his tower, it was noted that it began to list on one side, out of perpendicular. He, however, hoped for the best, and continued building; at the same time he made the pillars on the sinking side higher than on the other side, in order to compensate for the sinking. This, however, did not seem to do much good, for still the tower proceeded to lean more and more.

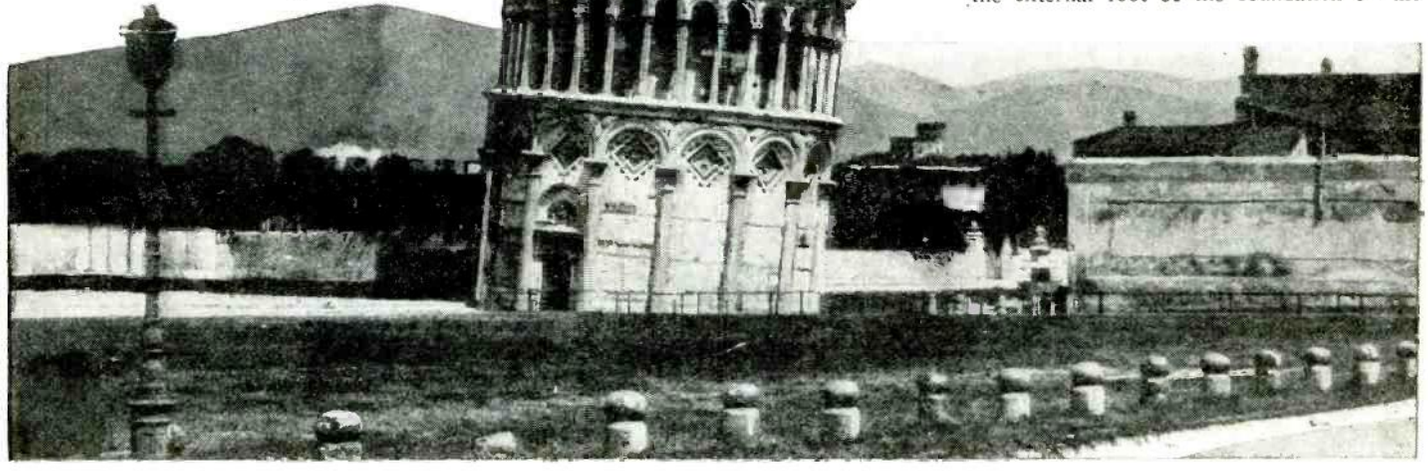
For sixty years, the unfinished marble tower was left standing, when the Pisans called in Benenato. He continued to build it up to the fourth story, and still the tower sank. After Benenato had died, the Pisans called in a German by the name of William of Innsbruck, who also tried to force the tower back to the perpendicular by making the pillars of the fifth and sixth stories longer on the sinking side than on the other. He too became discouraged and quit the job, and for another hundred years the tower stood unfinished.

Finally, another local architect, Tommaso Pisano, proceeded to finish the tower. He merely added the bell cupola on the sixth story and further inclined his cupola toward the perpendicular. The tower by that time was finished, and had its present appearance.

Recent measurements have shown that the tower is still sinking, although very little at the present time, but sufficient so that in time to come, unless something is done, it will surely fall. Once the top of the tower goes beyond its center of gravity, the tower must crash down.

Since 1817, the overhang of the seven stories has increased a minimum of about one-twelfth of an inch per year. Part of this increase was due to excavations made in 1838 and 1839 for the purpose of studying the foundations at their lowest part. Recently, from 1914 to 1927, the last increase of one-third of an inch has been at the rate of about 1/25 of an inch per year. The movement never ceases, although it is exceedingly slow. Recently the municipality of Pisa appointed a commission of engineers to study the cause of the trouble and how to bring about the cessation, and thus insure the stability of the tower for the future. The first report of this commission is dated July 29, 1927, and following are some extracts as published in *La Nature*.

At the right we have a very excellent picture of the world-famous leaning tower of Pisa. This famous architectural wonder leans approximately 13 feet from the true vertical. Water has undermined the foundation, and steps to overcome this or else move the tower have got to be taken immediately.



DETAILS OF TOWER OF PISA

THE tower is a structure of eight stories in height, with a total height of 57.05 meters (187 feet) between the bottom of the external foot of the foundation on the north side and the upper part of the last story 56.705 meters (186 feet) on the same side. Opposite this the corresponding south side is only 55.803 meters (183 feet), while the outside part of the foundation proper of this side is (—1.78) or 1.40 meters (4.59 feet) lower than the north. The interior has a diameter of 7.65 meters (about 25 feet). The thickness of the masonry between the first and the sixth cornice is about 2.47 meters (8.10 feet), while between the first cornice and the upper edge of the foundation its thickness is 4.12 meters (13.5 feet), and finally this foundation, which in-

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the Tower of Pisa

Methods Can Save Tower

By HUGO GERNSBACK

Member American Physical Society

creases inside and out, has a crown of 7.365 meters (24 feet) of thickness, with an interior space of 4.65 meters (15.25 feet) diameter, (the exterior circle being 19.75 meters (64.69 feet). The height of this foundation is 2.70 meters (8.85 feet) to 2.80 meters (9.28 feet), of which the last 0.40 meter (15 inches) of the base is laid up without cement, as footing stones.

NATURE OF THE SUPPORTING SOIL

THE supporting soil, according to Canavari, consists of:

1—Layers placed there of natural sand or clay, with a depth of 4.50 meters (14.7 feet) or 5.50 meters (18 feet), and containing the water-bearing stratum into which the foundation penetrates.

2—A layer of gray clay, 1 to 2.50 meters thick (3.28 to 8 feet).

3—Clay and sandy layers fine yellow or greenish, sometimes with turi, to a depth of 10.50 to 11 meters (32 to 34 feet), containing an artesian stratum.

4—Finally, the blue compact clay with the remains of marine and fresh water shells (especially Cardium edule), in which foundations had to be established in order to have a basis somewhat consistent and not affected by subterranean water. Now this water has a slow current toward the sea, and without a doubt draws along with it solid matter finely divided, leaving a void; and besides, there are springs which reach the surface at the foot of the monument, and whose rising speed has been rated at 7 cm. (2.8 inches) per second; finally, in its original construction, as well as in 1838 and 1839, excavations were made on the south side.

CAUSES OF THE INCLINATION OF THE TOWER

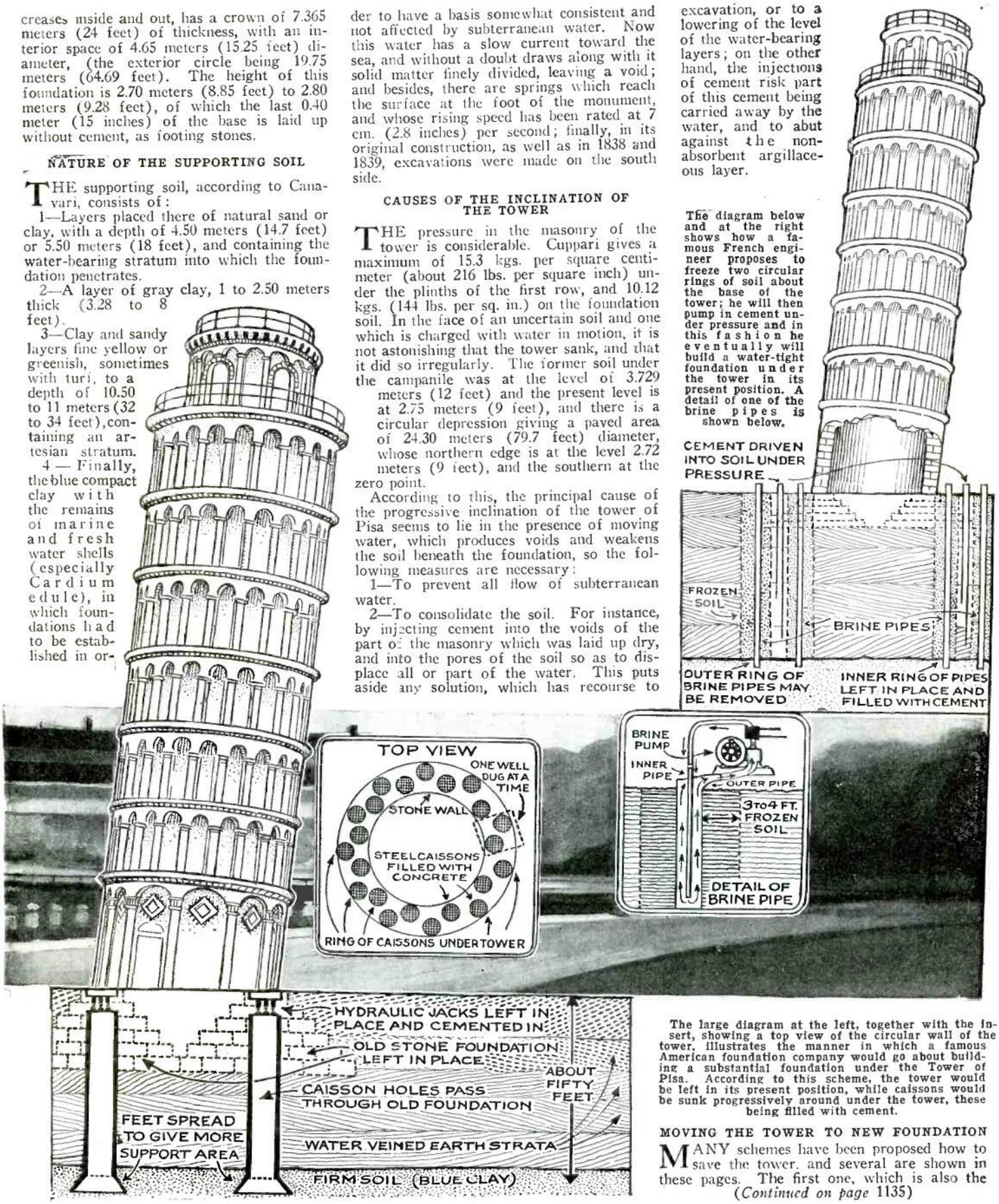
THE pressure in the masonry of the tower is considerable. Cuppari gives a maximum of 15.3 kgs. per square centimeter (about 216 lbs. per square inch) under the plinths of the first row, and 10.12 kgs. (144 lbs. per sq. in.) on the foundation soil. In the face of an uncertain soil and one which is charged with water in motion, it is not astonishing that the tower sank, and that it did so irregularly. The former soil under the campanile was at the level of 3.729 meters (12 feet) and the present level is at 2.75 meters (9 feet), and there is a circular depression giving a paved area of 24.30 meters (79.7 feet) diameter, whose northern edge is at the level 2.72 meters (9 feet), and the southern at the zero point.

According to this, the principal cause of the progressive inclination of the tower of Pisa seems to lie in the presence of moving water, which produces voids and weakens the soil beneath the foundation, so the following measures are necessary:

1—To prevent all flow of subterranean water.

2—To consolidate the soil. For instance, by injecting cement into the voids of the part of the masonry which was laid up dry, and into the pores of the soil so as to displace all or part of the water. This puts aside any solution, which has recourse to excavation, or to a lowering of the level of the water-bearing layers; on the other hand, the injections of cement risk part of this cement being carried away by the water, and to abut against the non-absorbent argillaceous layer.

The diagram below and at the right shows how a famous French engineer proposes to freeze two circular rings of soil about the base of the tower; he will then pump in cement under pressure and in this fashion he eventually will build a water-tight foundation under the tower in its present position. A detail of one of the brine pipes is shown below.



The large diagram at the left, together with the insert, showing a top view of the circular wall of the tower, illustrates the manner in which a famous American foundation company would go about building a substantial foundation under the Tower of Pisa. According to this scheme, the tower would be left in its present position, while caissons would be sunk progressively around under the tower, these being filled with cement.

MOVING THE TOWER TO NEW FOUNDATION

MANY schemes have been proposed how to save the tower, and several are shown in these pages. The first one, which is also the

(*Continued on page* 1135)

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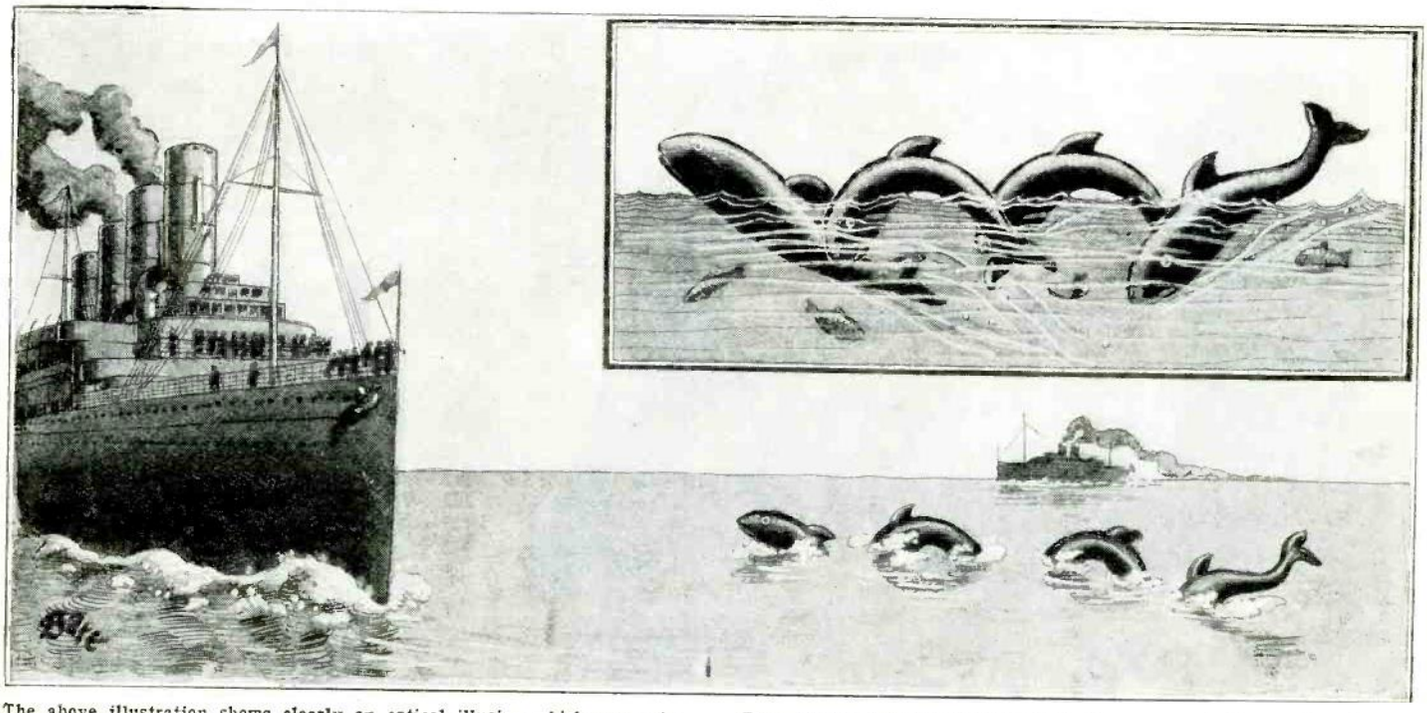
Sea Serpents---An Optical Illusion

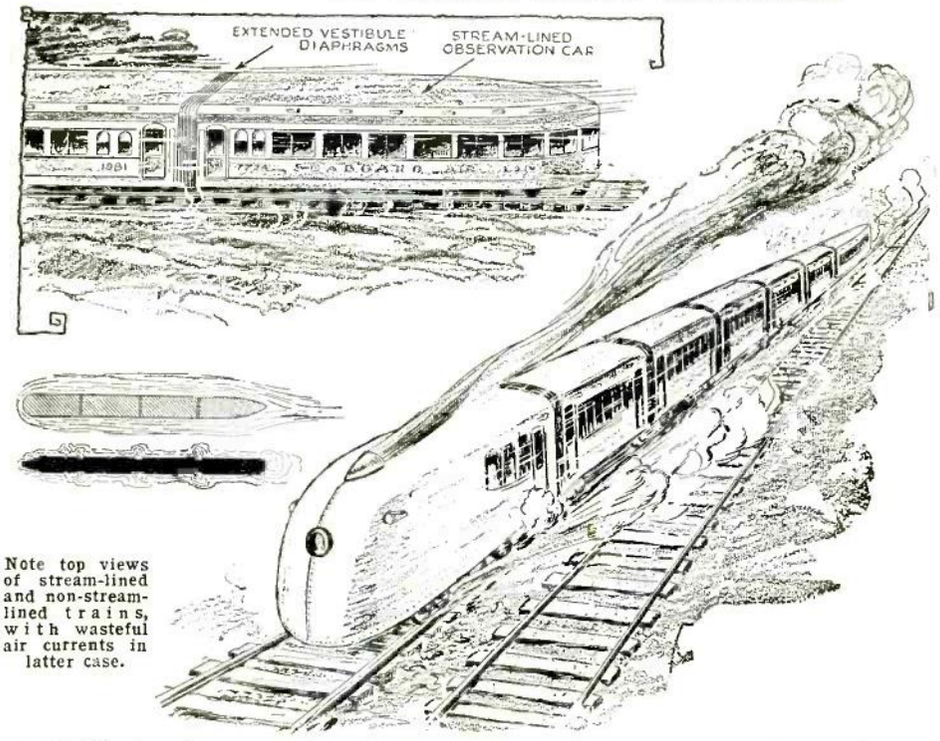


The above illustration shows clearly an optical illusion which seems to be a sea serpent when viewed from the surface of the water at a distance.

The supposed sea serpent was merely the movement of a number of young whales which propelled themselves through the water, as shown above.

For many years *sea serpents* have terrified certain navigators, who have sworn that they have seen these huge denizens of the deep. These serpents, however, were never seen when the ship drew up close, but always at a distance. A logical explanation has now seemed to be reached as to the origin of the sea serpent myth. The movements of a group of small whales, when viewed from a distance, are remarkably like that of a huge shiny black sea serpent. Navigators who proclaimed that they had seen these monsters were tricked by this optical illusion, which is illustrated in the above drawing.

Streamlined Trains More Efficient

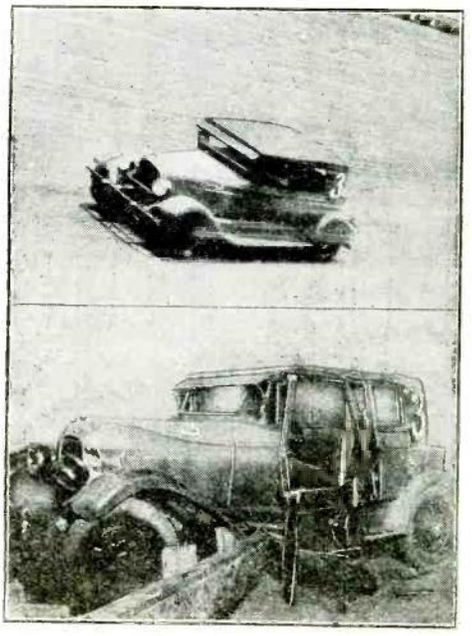


Note top views of stream-lined and non-streamlined trains, with wasteful air currents in latter case.

WITH the advances made in aerodynamics in the past ten years, there is no reason why any vehicle traveling at high speed on the surface of the earth, should not be properly streamlined, either to increase its speed, or reduce the power required to propel it. Since passenger trains have reached their maximum economical speed, a plan has been advanced to streamline the observation coach at the rear of the train, and also to utilize extending vestibule diaphragms, as shown in the sketch. The air resistance would thus be reduced about forty-six per cent with an equivalent reduction in fuel consumption. This system may be further improved by streamlining the locomotive pulling the train. The effect of streamlining the train and the equivalent reduction in resistance, may be seen by referring to the drawing which shows the top views of a streamline and non-streamline trains.—*F. E. Loudy.*

Curious Accident

After finishing 2,000 miles at a new record for closed cars, this sedan traveling at 65 miles per hour, turned over on a wet track, skidded fifty feet on its roof, righted itself, and crashed through the guard rail of the track. After being out of the test seven hours for body repairs, the car finished the 15,000 mile grind, averaging 62.7 miles per hour. The photos below show the car making about 65 miles per hour, at the beginning of the test, and also, the appearance after the smash occurred. *Photo courtesy Auburn Automobile Co.*



Above we have a photo showing a sedan before and after the crash.

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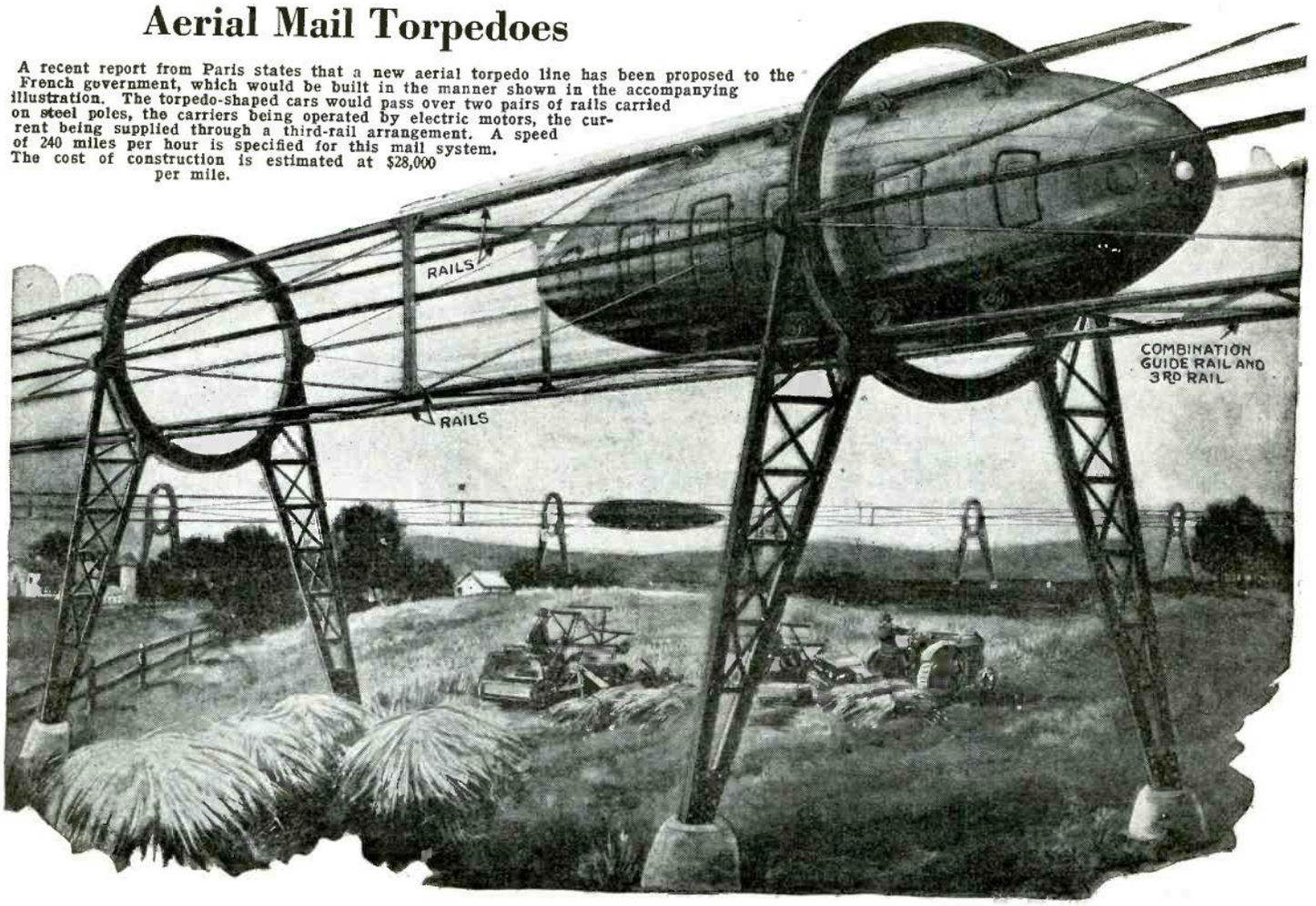
Can You Answer These Scientific Questions?

SCIENCE and INVENTION Magazine readers, especially our thousands of friends in schools and colleges everywhere, have frequently testified in their letters to the editors that they obtain invaluable help from the columns of this magazine, in clearing up technical questions which arise daily. It is a recognized fact that everyone today, including those of both sexes, are expected to have a fairly good general knowledge of the latest scientific developments and discoveries. It is quite impossible to obtain this knowledge of the latest conquests in science from text-books, as they are usually revised but once a year, and in many cases not as often as that. You will find the questions below a good challenge to your knowledge of modern science, and we advise you to form your own answer, before you turn to the page referred to in each case.

1. How is rubber made from such plants as the Guayule shrub and the cacti? (See page 1074.)
2. What is the average elevation possible in degrees for the 16-inch guns on a modern battleship? (See page 1075.)
3. What advantages, if any, are obtained by designing special trans-oceanic airplanes suitable for flying at an altitude of 40,000 feet, instead of the usual lower altitudes of 10,000 to 15,000 feet? (See page 1076.)
4. Is it possible to freeze the soil under the tower of Pisa, and construct a new foundation under the tower in its present position? What other scheme would you suggest? (See page 1078.)
5. What advantage is gained in designing high voltage electric cables with hollow centers through which oil is forced? (See page 1080.)
6. Do you think it will ever be possible to make sustained flights in man-propelled airplane without any engine at all? (Form your answer before reading page 1082.)
7. In regard to human nutrition, what is the effect of the complete (temporary) withdrawal of food from the living organism? (See page 1087.)
8. Do you think it would help very much to streamline the observation car on a railroad train as well as the locomotive; if so, what per cent in reduction of fuel would be obtained approximately? (See page 1090.)
9. Do animals actually grow new limbs when they lose one through accident or otherwise? (See page 1091.)
10. What is a comet, and name three particular features of these remarkable astronomical displays? (See page 1095.)
11. What is the name of the animal substance used in building the gas cells for the large dirigibles, such as the Los Angeles? (See page 1099.)
12. An electric fan helps to keep you cool in the summertime; will it also help to keep ice cream cool and prevent it from melting so rapidly? (See page 1102.)

Aerial Mail Torpedoes

A recent report from Paris states that a new aerial torpedo line has been proposed to the French government, which would be built in the manner shown in the accompanying illustration. The torpedo-shaped cars would pass over two pairs of rails carried on steel poles, the carriers being operated by electric motors, the current being supplied through a third-rail arrangement. A speed of 240 miles per hour is specified for this mail system. The cost of construction is estimated at $28,000 per mile.



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May

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Science and Invention

IN THIS ISSUE

"DIRIGIBLES"

By C. E. ROSENDAHL, U.S.N.

Commander of U. S. S. Los Angeles

SEA ANCHOR FOR AIRSHIPS

See Page 14

EX[illegible]NG COMPANY, 230 FIFTH AVENUE, NEW YORK, N. Y.

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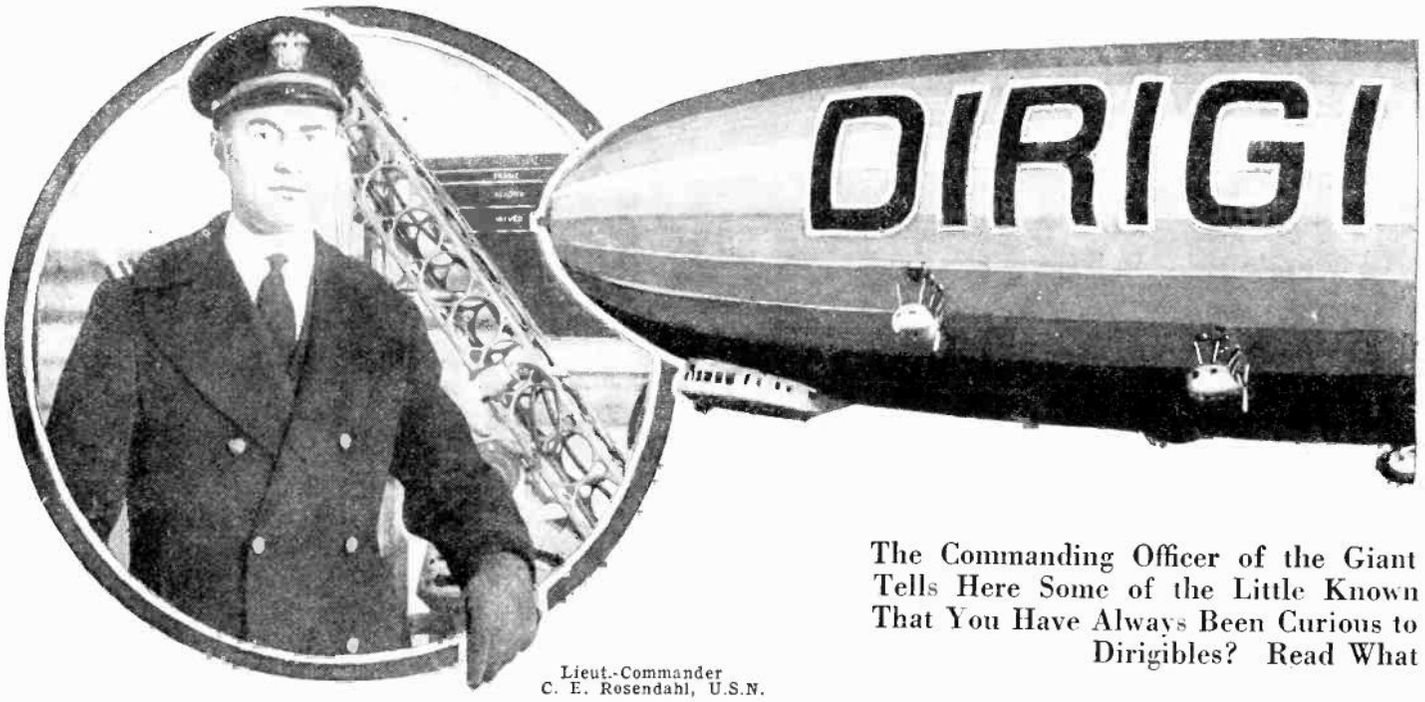


Lieut.-Commander
C. E. Rosendahl, U.S.N.

The Commanding Officer of the Giant Dirigibles? Read What Tells Here Some of the Little Known That You Have Always Been Curious to

QUESTIONS ASKED BY H. GERNSBACK, EDITOR, FOLLOWING RADIO TALK OF LIEUT. COM. C. E. ROSENDAHL, U. S. N., FROM WRNY.

1. Q. In your opinion, can a huge dirigible of the Los Angeles' type compete successfully with airplanes in carrying passengers?

A. There is no competition between the airplane and airship if each is properly employed. To use an airship to do the work of an airplane is as extravagant and inefficient as the use of a sea-going steamer on a short coastal run or on ferry boat duty. The airplane is and will probably always be a short range carrier, while the airship is fundamentally a long range vehicle.

2. Q. What do you believe the maximum speed that airships can obtain for commercial traffic?

A. It is believed that a speed of about 100 miles per hour will be attained by dirigibles of future commercial size.

3. Q. What provisions if any have been made in passenger carrying across the oceans to safeguard passengers if airships were forced down into the ocean?

A. An airship in trouble is not necessarily forced down in the ocean—in fact, she would fly as a free balloon, in case all motors failed; but there is extremely little likelihood that all of six or eight individual power plants would fail simultaneously. Airships carry sea anchors similar to surface ship practice. There are many instances on record where German Zeppelins—badly damaged in war—returned safely to their bases. Safety lies with staying with a ship and flying to her base.

4. Q. If lightning struck one of these huge helium-inflated airships, what damage would be done?

A. Even hydrogen-inflated airships have been struck by lightning without any damage. An airship is a huge, thoroughly-bonded metallic structure, that would readily dissipate an electric charge; added safety being assured by the use of the absolutely non-inflammable helium gas as the inflation medium.

5. Q. Can this country produce sufficient helium for any amount of dirigibles?

A. The United States has practically a world monopoly of the supply of helium. Nowhere else in the world is there a sufficient quantity of helium-bearing natural gas to pay for its production. Recent reports indicate that there is practically an unlimited supply of helium in certain gas-bearing fields in the United States—certainly enough for all the airships we shall operate for scores of years to come.

6. Q. What are the advantages of helium over other lifting gases?

A. Helium is a safe lifting gas in that it will absolutely not combine with any other element and therefore cannot burn nor explode. It is next to the lightest gas known and available for airship inflation. It has 92% of the lifting power of hydrogen, and its much greater safety over hydrogen makes its use of the utmost value.

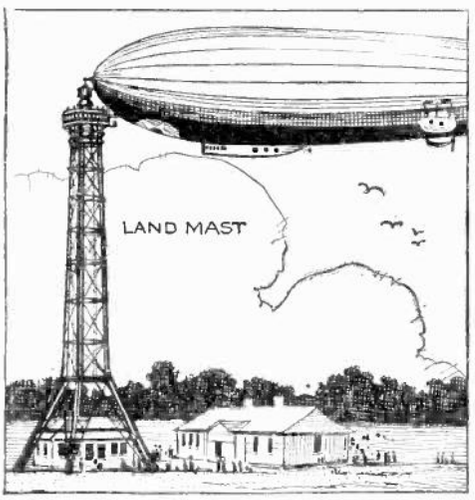
7. Q. Can an airship, while moored to its mast, outride practically any storm that may come along, including a hurricane?

A. An airship moored to a mast can ride out very severe storms—certainly any containing winds up to the speed at which the ship itself is designed to fly. In the case of hurricanes or tornadoes greater safety lies in taking the air and flying out the storm, just as a steamer puts out to sea in severe storms, heaves to at sea, or runs around severe disturbances.

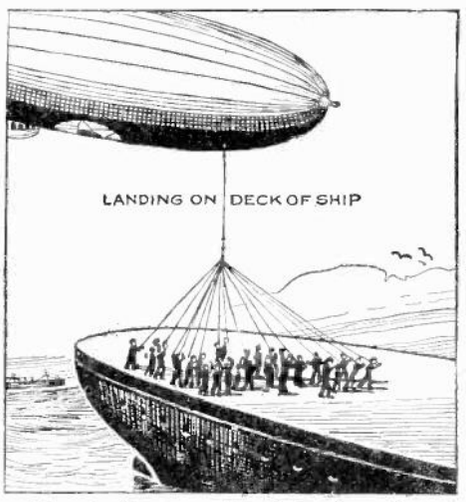
THE year 1928 will be an unusually important and spectacular one for dirigibles; it is not necessary to consult an astrologist to glean this from the stars, as there are other unmistakable signs already apparent. 1927 saw many triumphs for the airplane—its records are written in history. Outwardly, 1927 was a quiet one for dirigibles; actually, much unseen and vital experimental work progressed and some new construction continued in its early stages. It is on this dirigible or airship phase of aeronautical activity that I wish to discuss briefly.

HEAVIER-THAN-AIR CRAFT DEFINED

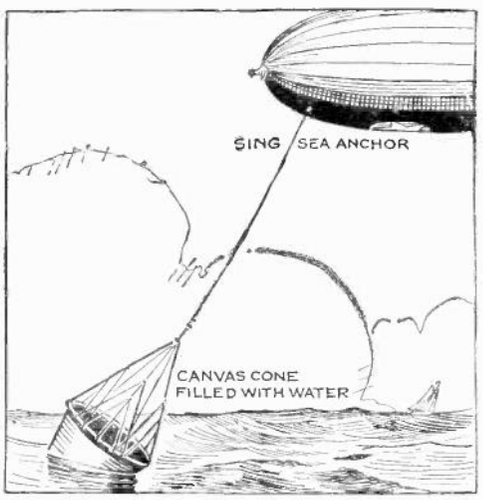
MANY people do not distinguish between "heavier-than-air" craft (i.e. airplanes) which must depend on their engines to hold them aloft as well as to drive them through the air, and "lighter-than-air" craft (or dirigible balloons) which are sustained by some buoyant medium such as helium gas and devote practically the entire effort of their engines towards propelling them. Thus the term "airship" is sometimes used indiscriminately for all forms of aircraft. We in the lighter-than-air branch of aeronautics feel that the term "airship" properly should be applied only to lighter-than-air craft, as they are fundamentally "ships" and incidentally ships that float in air. Airplanes are much more widely distributed than airships, and naturally the plane and its habits and character-



One method of mooring dirigibles is shown above. The ship is tied to a land mast.



When landing upon the deck of a ship, a number of ropes are employed as shown here.



One of the newest inventions is a sea anchor for dirigibles used as shown.

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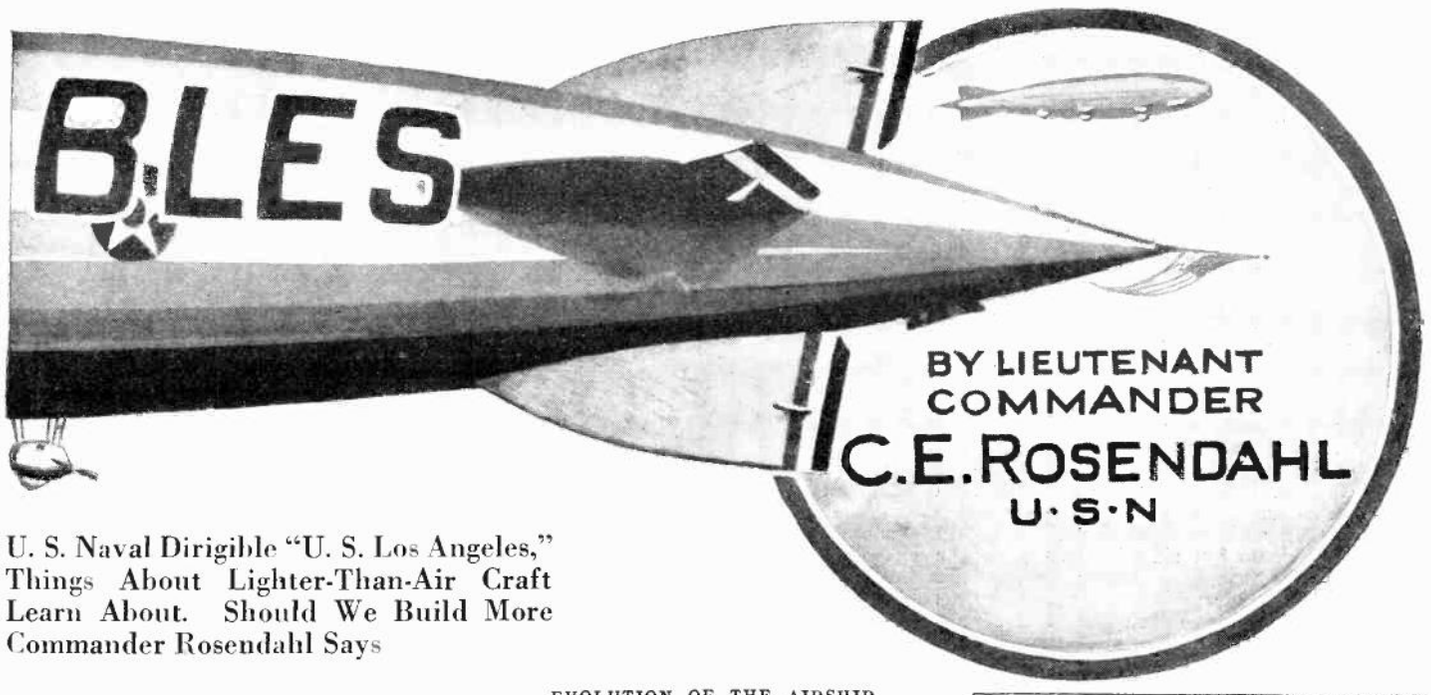


U. S. Naval Dirigible "U. S. Los Angeles," Things About Lighter-Than-Air Craft Learn About. Should We Build More Commander Rosendahl Says

istics have therefore become more commonly known than those of its scarcer cousin, the airship. However, this unfamiliarity with the airship will soon vanish, for the realization is dawning that large airships—often referred to in the past as "Zeppelins"—are essential both to commercial transport and to the national defense.

DIRIGIBLES FOR SAFETY AND COMFORT

MANKIND continues to demand greater speed in transportation—think of the vast amount of effort spent to obtain speed! Is there anyone who hasn't been thrilled at the tales of the magic carpet of the Arabian Nights and its ability to annihilate distance? High speed trains and fast steamships demand extra fare and we continue to patronize and support them. Further increases in railroad and steamship speeds are very expensive and difficult to obtain. As soon as the speediest transport of all—that by air—becomes more generally realized with safety—mankind is sure to take quite liberally to the use of aircraft—particularly if comforts and conveniences may be had simultaneously with the greater speed. Airplanes and airships are this next available means of supplying speedier travel—the airplane for short or moderate distances, the airship for long distances. Airplanes can provide a certain degree of comfort but it is the airship which can supply the maximum of comfort and safety in the air for longer voyages.

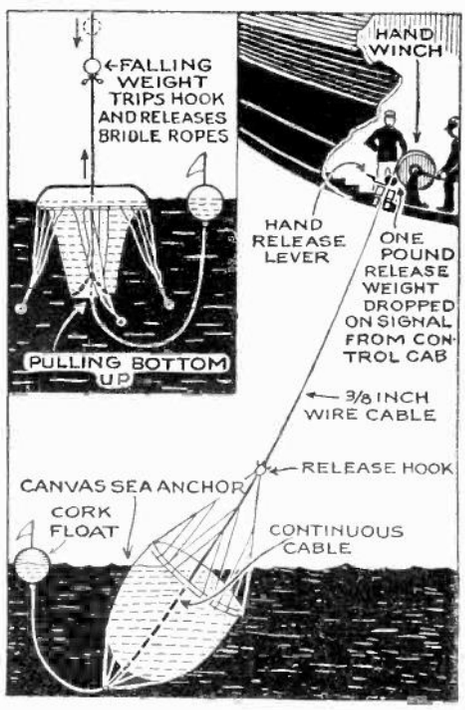
EVOLUTION OF THE AIRSHIP

PERHAPS you might be interested in the evolution of the airship. In 1783, that is, about one hundred and forty five years ago, the first balloon flight was made. Men had observed that hot air would rise; therefore by inflating a bag or container of light material with heated air, the container could be made to rise and take with it a basket or car in which to carry the passengers and other loads. Soon man was able to produce hydrogen gas in sufficient quantity to inflate a balloon and since hydrogen is so much lighter than air, it has always been a most efficient lifting gas. Of course, balloons drift with the wind, and man soon became desirous of providing them with motive power so that he might go in any direction independent of the wind. Early effort consisted of rowing with silken oars but of course this method was not practical. In 1852 the first power driven or dirigible balloon was built. It derived its motive power from a three-horsepower steam engine. The modern airship had to wait for the development of the gasoline engine and a light strong material with which to build the structure. It was in 1900 that Count Zeppelin completed and flew his first rigid airship in Germany. Our first American airship was built in 1908.

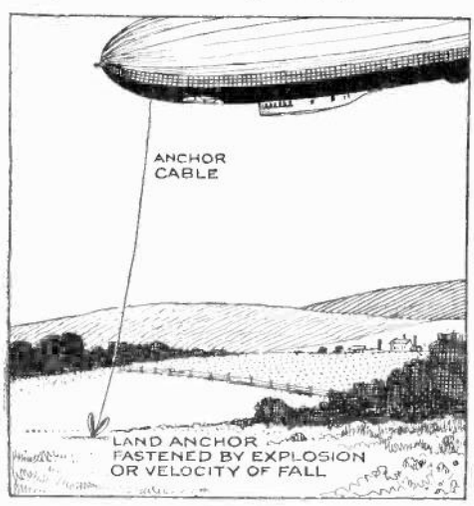
LIGHTER-THAN-AIR CRAFT CLASSIFIED

AT this point let me classify for you lighter-than-air craft or those forms of

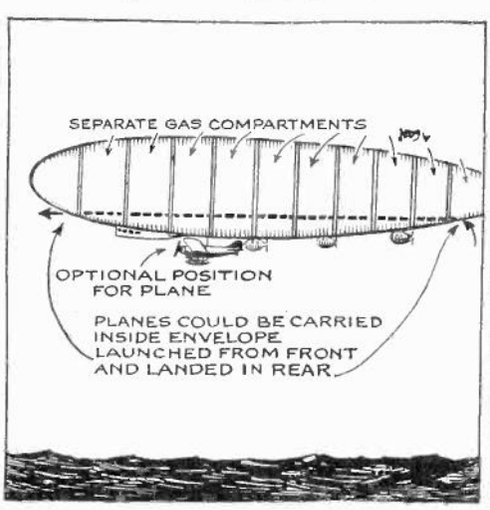
(*Continued on page 79*)



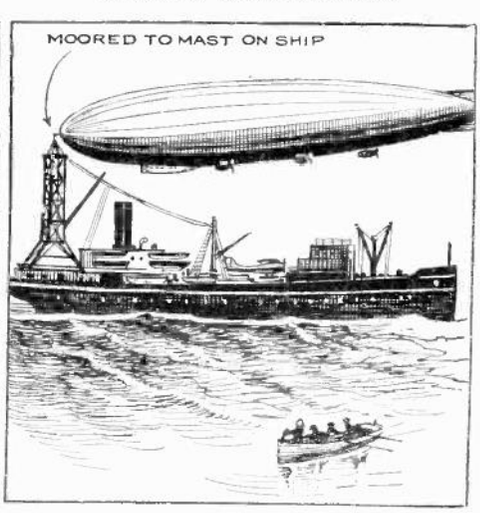
The above illustration gives all the details of the new canvas sea anchor.



An emergency landing can be effected by using a land anchor which can afterwards be cut loose.



Modern dirigibles have separate gas compartments. The U. S. Navy will fit dirigibles for carrying airplanes.



A dirigible can be moored to a special mast on a ship, as was recently done with the "S. S. Patoka."

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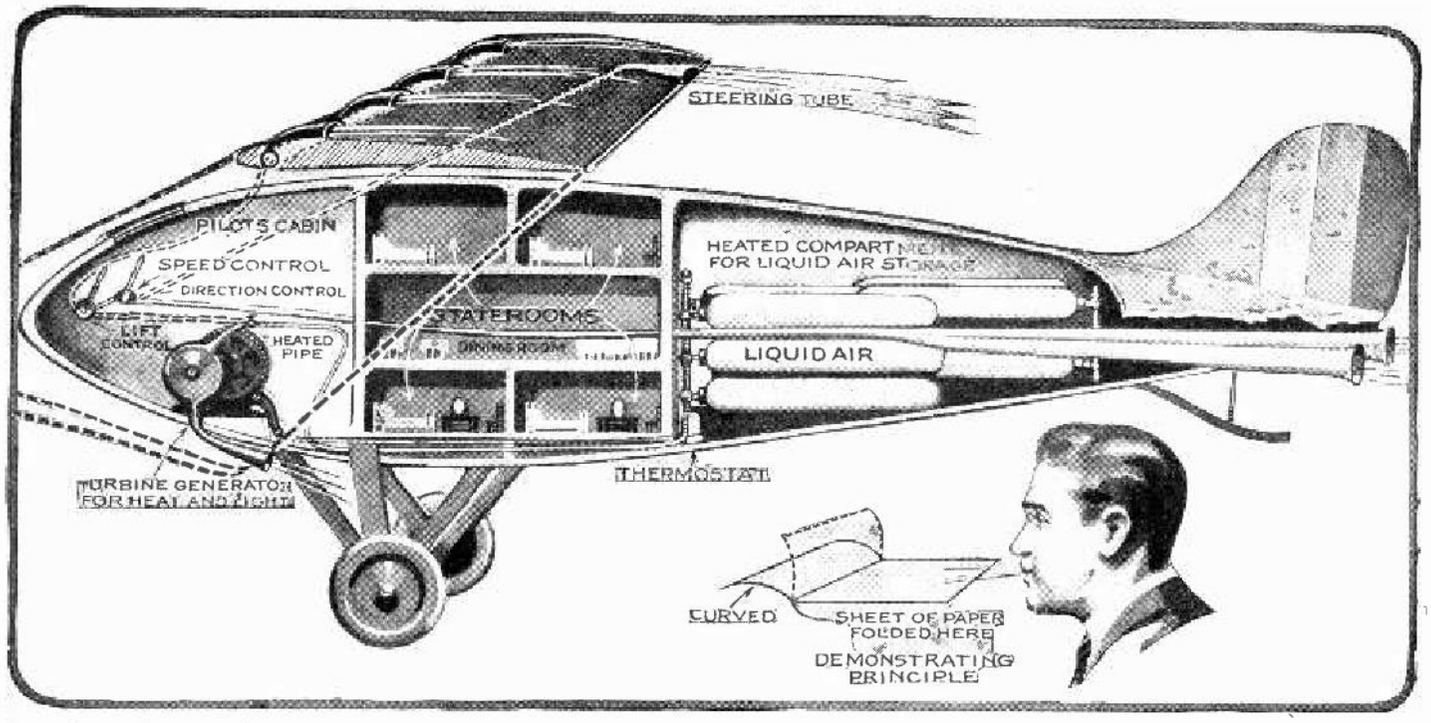

Conception of the proposed type of engineless plane which will obtain its lift by streams of air forcibly ejected through special nozzles mounted along the edge of the wing. Air tubes propel and steer the plane because of the reaction effect. Insert shows the operating principle.

Engine-less Plane Driven By Liquid Air

Propellers and Engines to Be Supplanted by Novel Method Employing Liquid Air for Propulsion and Vertical Lift

By AUGUSTUS POST

WHEN Glenn Curtiss was looking for a landing-place half-way between Albany and New York at the time of the first long-distance flight in this country, May 28, 1910, he found just the place he wanted, a broad expanse of lawn in front of an imposing public building near Poughkeepsie. When we asked permission to make a landing there, the Superintendant, Dr. Taylor, replied genially: "Why certainly, come right in! Here's where they all land!" It was the State Lunatic Asylum.

Even as late as this year, this was the popular notion of the place where flying-machine inventors belonged. Nowadays the public is going crazy over aviation, and the only level-headed ones are the Lindberghs who do the great things and the inventors who dream them. These dreamers, the "crazy inventors," are now looking as far ahead into the impossible, as the Wrights were when they were building a heavier-than-air machine to navigate the air above the clouds. The present-day dreams are of the navigation not only of air but of space, by the application of methods new to flight, including the reaction principle and the utilization of liquid air, one of the most condensed forms of mechanical energy known. The possibility of a fuel-less motor even seems to be coming up over the horizon.

LIQUID AIR FOR PLANE PROPULSION

CURIOUSLY enough, the very first engine that we know to have been constructed, Hero's engine, used the reaction principle. Most of us have in our childhood seen this applied, if we owned one of the toy tin boats intended for sailing in bathtubs and fitted with an alcohol lamp and boiler, a jet of steam furnishing the force that pushes it along. A jet of air has been used of late years by two French engineers, Papin and Rouilly, to revolve the

Augustus Post, the author of this article, is a pioneer aviator and aeronautic expert. Mr. Post has been active in aviation circles from the days of Wright's Ft. Meyer flights. As early as 1910 he flew in various meets. As an aid to Alan R. Hawley, the winner of the Gordon-Bennett Balloon Race in 1910, he was lost in Labrador wilderness for ten days. He also drew up the rules for the Raymond Orteig prize won by Charles Lindbergh.

blade of their revolutionary type of helicopter, by forcing an air blast from the rear edge of its propeller blade. This naturally suggests the possibility of driving a machine through the air by the expansion of a gas through specially designed nozzles that would give the maximum thrust. One of the most concentrated forms of mechanical power may be obtained from the expansion of liquid air. This is expensive, and its efficiency is not yet satisfactorily proved if we consider propulsion alone, but if in addition to the propulsive effect of this rapid exhaust and expansion of the liquid air, these specially constructed nozzles are directed over the upper surface of an aerofoil—or airplane wing—this tends to create an upward lift. This upward lift is easily demonstrated by a familiar experiment with a piece of paper five inches long and two inches wide, creased across at about a third of its length, the short end curved as in the drawing.

Blow above the upper surface of the flat section and the curved section will move up and against the stream of air, demonstrating how the air flowing over the upper surface of an airplane lifts the wing. Liquid air in process of expansion by heat through the properly constructed nozzles over the surface of the airplane wing would in like manner tend to lift it as well as to drive it forward.

HOW LIQUID AIR PROPELLED MOTOR CAR

I HAVE ridden in a steam automobile in which liquid air was used to take the place of steam; it could be used anywhere that compressed air is used for propulsion. It was used with phenomenal success by Dr. Sidney Morton Baruch in driving a liquid air turbine directly connected to the propeller of his aerial torpedo.

One of the advantages of liquid air for aerial flight, and one that at once impresses anyone interested in the long-distance flights of the future, is that it is not necessary to take into the air any machinery for the purpose of generating power, for this generating has all been done on the ground in the process of liquefying, and in a small amount of liquid air we have stored up an

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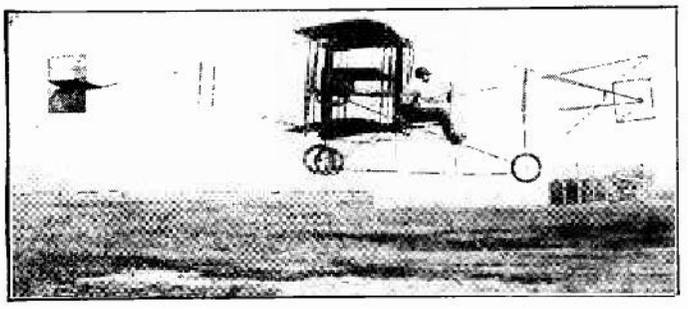
immense driving force. This makes it specially well adapted to "unmanned" planes and aerial torpedoes, and in general in instances when imperative necessity makes cost of no importance.

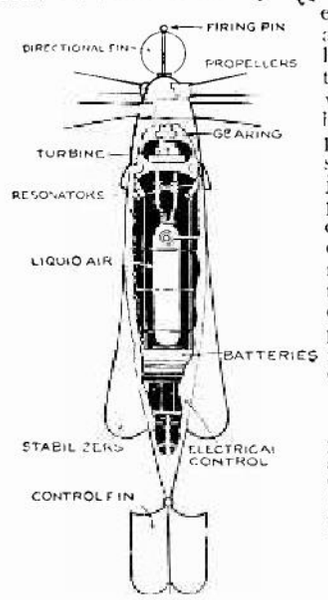
The air travel of the future, whatever fuel may be used, will probably be carried on not only at the altitudes at present commercially available—which have already added 16 miles to the diameter of the earth, by giving mankind command of 8 miles upward on either side—but at heights far greater than are at present deemed practicable. This is bound to be the case with long flights. The resistance of the air at great altitudes being so much less, much higher speeds would be possible. The "superterranean express" with its enclosed cabin holding apparatus for oxygen-feeding of passengers and the maintenance of normal air-pressure, keeping up a speed of 500 miles an hour, may be here in a comparatively short time, if it but follows along the line of present conservative development. Maj. Gen. J. H. McBrien, President of the Aerial League of Canada, and a former officer of the Royal Air Force, goes even further, predicting a speed of a thousand miles an hour at a period not far distant. Our War Department is experimenting with an airplane to operate at a height of fifty thousand feet, fitted with liquid oxygen flasks and lined with plywood and quilted felt corduroy, to keep out the terrific cold. The airplanes of yesterday were rowboats hugging the shore of the ocean of air; we are bringing into being the Leviathans of the "high" seas of the sky, and it is on these high seas that the future of aviation lies.



This photo shows Mr. Post piloting one of the first airplanes. Compare this with modern constructions.

ROCKET AIRSHIPS

MAX VALIER, a German astronomer and aeronaut, has been attracting much attention not only at home but abroad, by his statements that we need not be restricted, through our use of the present-day type of flying-machine, to heights of eight or nine miles now possible for flying, but may operate at a hundred miles up, or even more. His ideas are in line with the researches in various countries of Profs. Ziolkowsky, Goddard, Oberth, and von Hoefft, who with other experimenters have brought the idea of "projection into space," appreciably nearer to possibility. As evidence of the resulting change of mind on the part of the public, the editor of as conservative a periodical as the English magazine *Discovery* recently featured a description by Herr N. Valier of his "space-plane," saying editorially, "We have printed this author's views, not because his proposition should be judged as practical politics of the moment, but rather as opening up possibilities in a field which has as yet been the subject of a little serious research."



Here is the aerial torpedo designed by S. M. Baruch, employing liquid air for propulsion.

A rocket-ship such as Herr Valier plans, would start at an angle of at least 80 degrees, reaching as soon as possible the thin-air stratum. After 17 seconds the ship is calculated to reach a speed of 400 meters per second at 3,000 meters high; after 35 seconds, at 20,000 meters high, a speed of 800 meters; after 45 seconds at 50,000 meters high and seventy kilometers horizontal distance from the starting-point, the horizontal speed would be 2,000 meters per second. At this rate it would take an hour and a half to go from Berlin to New York.*

Herr Valier answers the objection that his proposed machine could not move through empty space because this has no resistance for power development, by explaining that just as in traveling through the atmosphere the rocket does not rely on the support of air, but moves by its own internal energy through it, so his "space ship" would move forward by means of the expulsion through nozzles as exhaust, of the gas molecules developed by the explosion of the propellant fuel, whereby a continuous recoil would exist to drive the ship onward.

The imagination of writers and artists has always played with the idea of interstellar communication. But it is something really new for the imagination of inventors and engineers to take it into sober consideration, and to make calculations based upon exact data. Herr Valier says:—

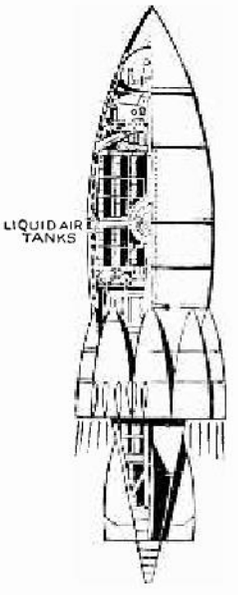
"Whether we are able to build rockets of such colossal power that they will be able to force a passage to a point beyond the field of gravity of the earth and other planets, is another question. Today we know the exact formula from which to calculate theoretically the necessary recoil and we know the "ideal terminal velocity" including the overcoming of the air-resistance, of 12,700 meters per second. The real recoil of the rocket is furnished in the product of the forced-out gas-mass per second and its exhaust speed. If the ship itself permits an ideal terminal velocity which is equal to the speed of the exhaust gas, then 63.2% of the total weight of the starting machine must consist of fuel: if double or treble the exhaust speed is to be attained, then must 86.5% or 95.2% respectively of the total weight be fuel, and there remains only from 13.5% to 5% for the actual weight of machine, including cargo.

"Therein lies the greatest difficulty of the whole problem with the present flying-machines; the liquid fuel carried is at most 35%, the tare weight is about 40%, crew 5 to 10%, so 15 to 20% remains for cargo. If one takes a comparatively cheap fuel such as powder, the results are far too small for high exhaust speed (highest 2500 meters per second) and hence insupportable conditions as between fuel, cargo, and tare weight of machine. On the other hand, a very high exhaust speed (4000 to 5000 meters per second) can be obtained from explosions of hydrogen with oxygen and of similar fluid propellants of high kinetic power. These, however, are too expensive, and too heavy, while much regarding their combustion remains to be investigated. *In fuel lies the greatest practical difficulty, even when the problem is successfully explained theoretically in other directions.*"

It is his belief that only a machine in which the method of working is quite independent of the surrounding air can open the path to the celestial spaces, and then only when it can develop sufficient power and carry fuel in great enough quantity. He thinks that the only method likely to be successful is the rocket system. It is his intention to advance along this path of development by way of the present airplane to the eventual "space-ship," working on the construction of a normal pursuit plane into whose wings will be fitted auxiliary rocket apparatus, thus making it possible to study, *during flight*, the workings of the rocket as a motive power.

It is of course to be understood that if the "space-ship" does really succeed in navigating at these immense heights above the earth's surface, there will be no putting one's head out of the window. At 25 miles up, daylight is faint; the sun is a ball of fire, but the light is not diffused, as there are no dust motes in the air—I have myself experienced an approach to this condition in a balloon flight to an altitude of 24,200 feet, and in an airplane at an altitude of 22,000 feet. Climbing to 50 miles above the earth, the ship would find no more air than would be found under the receiver of the best air-pump; and darkness is practically complete. At a hundred miles, according to Willis Moore in "The New Air World," the temperature is probably 459 degrees Fahrenheit below zero. Conditions for making human life possible must of course be maintained inside the cabin. Man must take his world along with him if he goes beyond the air, just as, under exactly opposite conditions, he manages to take it with him when he goes in a submarine below the sea.

Captain Thomas Scott Baldwin, our famous pioneer of dirigible navigation and construction, who, before he was the world's champion parachute jumper, began his career as an acrobat with Ringling's Circus, told me that the artists who drew the billposters displaying men turning somersaults over the backs of elephants always added a few elephants to those over which the men were at the time able to jump, and threw in a few extra somersaults for good measure. But so great is the propulsive power of an ideal that once the picture was drawn, the acrobats set themselves to equal it, and so the fiction became fact. Something like this continually comes to pass in the world of science, and its most picturesque illustration is nowadays in the field of aviation engineering.



Here is a view of a different style of rocket from that opposite. This is intended for interplanetary communication. The time will come when we will be able to send men to our sister planets in space.

* One kilometer is .621 miles.
¶ One meter is 3.28 feet.

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June

BROADCAST WRNY STATION

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Science and Invention

HARNESSING NATURE'S ELECTRICITY

See Page 110

EXPERIMENTER PUBLISHING COMPANY, 230 FIFTH AVENUE, NEW YORK

WHY BIG

The Opinions of Several Eminent Hydraulic Engineers as to the Probable Cause of the

H. WINFIELD

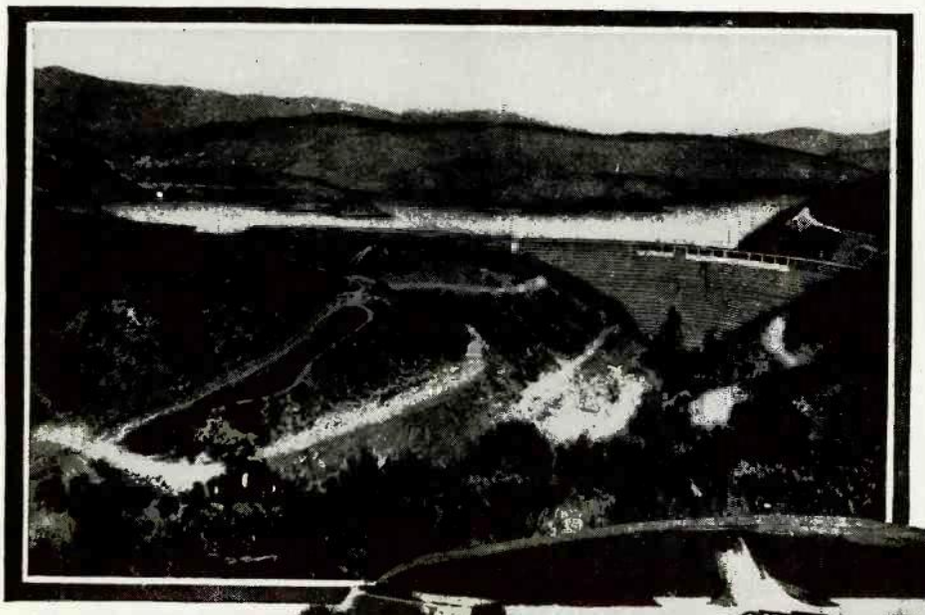
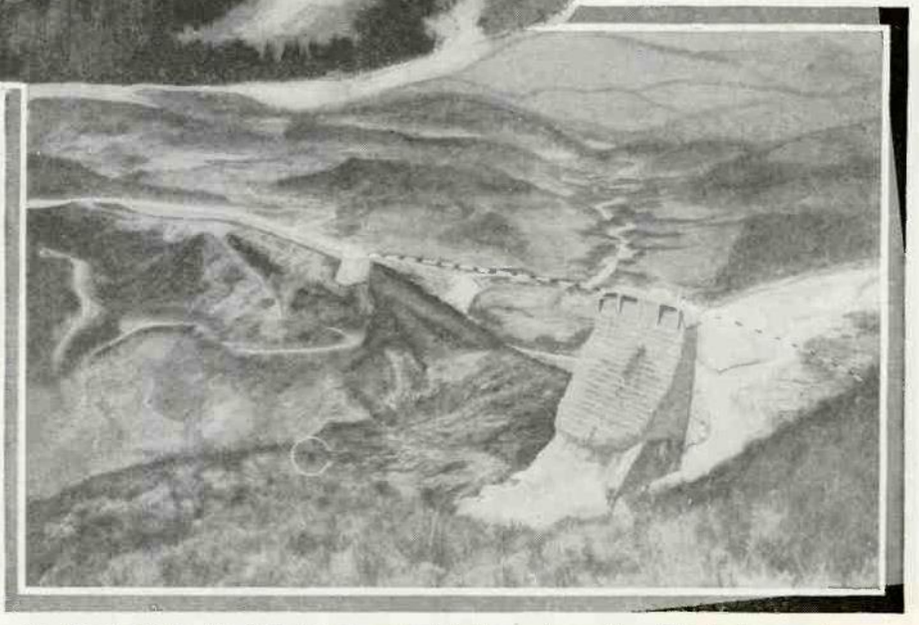


Photo above shows St. Francis Dam before it broke.

With a thunderous roar which terrified those who heard it, the St. Francis Dam in California "let go" unexpectedly, and the twelve billion gallons of water stored up behind it swept down the Santa Clara River Valley.

WITH a terrific booming sound that seemed to herald the coming of Judgment Day and the end of the world, twelve billion gallons of water stored up behind a huge concrete dam burst through it and went roaring down through the Santa Clara River Valley in California recently, spreading death and destruction as it went. It is considered probable that four hundred people lost their lives when the huge concrete dam, known as the St. Francis Dam, collapsed and liberated this huge quantity of stored up water, and just where the blame for this terrible catastrophe should be placed is a question which may never be answered satisfactorily. The accompanying pictures show some of the reasons why big dams, and of course little ones too, sometimes burst or collapse through improper engineering design or weak foundation materials under the dam or at the sides where the dam is anchored.

Mr. Edward Hyatt, Jr., State Engineer of California, after he had inspected the wreckage of the dam, refused to give any definite opinion as to whether the collapse was due to engineering mistakes or to natural causes over which man has no control, according to public press accounts. He ventured the opinion that the collapse of this huge concrete dam was probably caused by foundation weakness in the abutments of the dam. He stated further that the abutments of the dam were anchored in a red conglomerate rock, which was found to be very soft; but whether it was soft in its original state or had become so through action of the rushing water, he was unprepared to state. Mr. Hyatt is quoted further as having said: "that there was no question in his mind, that had the dam had a sufficiently strong foundation, the tragedy would never have happened." It was his opinion further "that in view of the fact that the center of the dam still remains upright," as the photographs herewith show, "that the good quality of the cement used was proven." The writer has found that



St. Francis Dam, after it had burst; note that the center portion still stands in place. Huge size of dam may be judged by noting man in white circle. Dotted line shows original dam contour.

DAMS BURST

Collapse of the St. Francis Dam Recently in California is Herein Set Forth as Told to

SECOR

among several engineers with whom he talked, in regard to the St. Francis Dam disaster, that one of the great scientific mysteries concerning the whole affair is, that it is hard to work out even a theory as to why both wings or sides of the dam should have given way, apparently within a few seconds of each other.

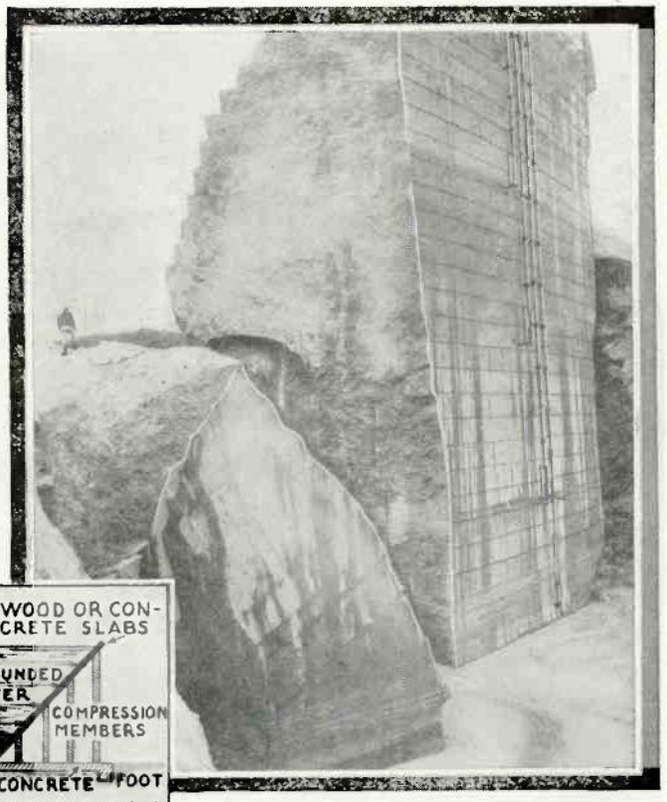
One of the prominent hydraulic engineers, whom the writer interviewed, a man of many years experience in building large concrete and other forms of dams, in this and other countries, stated that this was one of the greatest enigmas in the collapse of a big dam, such as the St. Francis, that he had come across in all his experience in dam construction and operation.

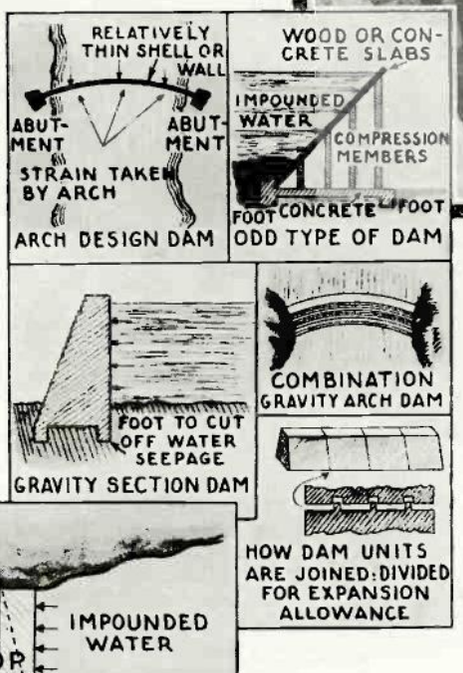
The engineer who built the St. Francis dam, Mr. William Mulholland, veteran chief engineer of the Department of Water and Power of Los Angeles, stated (according to the *New York Herald-Tribune*) in his recent testimony before a coroner's jury at Los Angeles, that he fully believed the St. Francis Dam to be safe, or else he would never have ordered a drop of water to be put in the storage reservoir behind it. Mr. Mulholland stated that after the dam was completed with the usual careful inspection from day to day, tests were made by means of core drillings. Mr. Mulholland recited in his testimony that he had visited the St. Francis Dam eleven hours before its collapse, and that leak conditions were very bad. Muddy waters observed in the reservoir indicated an earth leak, which is always more or less of a serious matter to engineers, press reports quote him as saying.

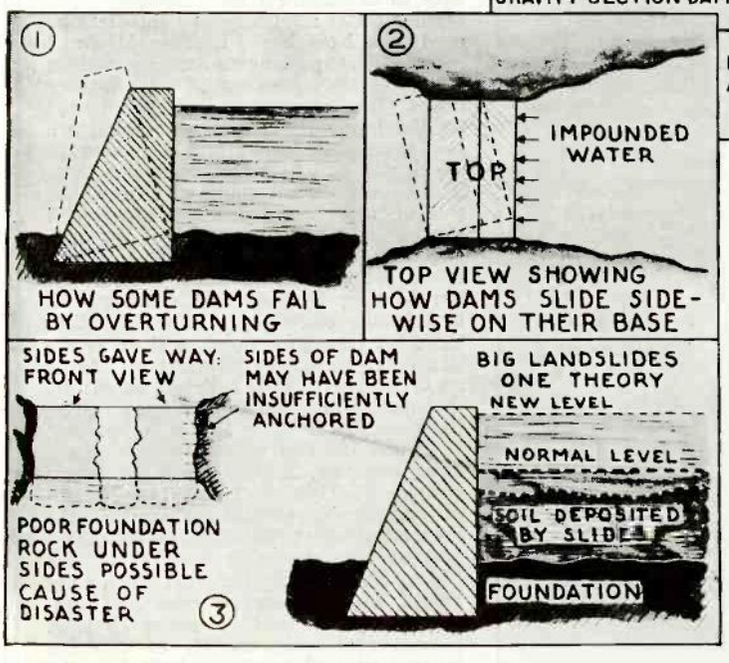
One of the eminent hydraulic engineers interviewed by the writer in New York City, a gentleman who knows Mr. Mulholland, gave as his opinion however, that there are always invariably some earth leaks around large dams, and that the observance of muddy waters in the reservoir or below the dam did not at all necessarily indicate that the dam might suddenly fail or burst. The chief engineer, Mr. Mulholland, had visited the dam at the call of the keeper, Tony Harshelfeger; the keeper had seen new leaks through the earth and sent for his chief. Tony Harshelfeger was one of those who died when the dam broke.

The gigantic size of the solid concrete St. Francis Dam in California, which recently gave way and liberated twelve billion gallons of water, can be judged from the photograph at the right and noting the comparative size of the man standing on one of the broken concrete fragments. The man is visible at the extreme left of the picture. Several different types of dams are shown in the center drawing below. In the arch type dam the wall is usually about two feet thick. →

The St. Francis Dam was of the gravity-arch type illustrated. An odd type of dam is the wedge shape design illustrated. The method of dividing large concrete dams into several sections to allow for expansion, is illustrated. ↓







At the right of Fig. 3 above, we see how major landslides may have caused water level behind the St. Francis Dam to rise, the large deposit of silt, by its weight, increasing the total pressure on the dam. The landslide theory was advanced early by a prominent engineer familiar with the St. Francis Dam. Engineers who inspected the site of the broken dam are said to have found evidence of such landslides.

← **Engineers in general do not care to express any positive opinion as to why the St. Francis Dam collapsed. The pictures at the left show, at 1 and 2, how dams frequently fail in their purpose. As shown at 1, gravity dams not sufficiently heavy, may turn over, either forward, or else their base may be thrown forward and up; or again they may be skidded sidewise on one corner or another, by the water pressure, as shown at 2. One expert believes that the foundation rock under the St. Francis Dam disintegrated, the side rock giving way for the same reason.**

NATURE OF BASE IMPORTANT

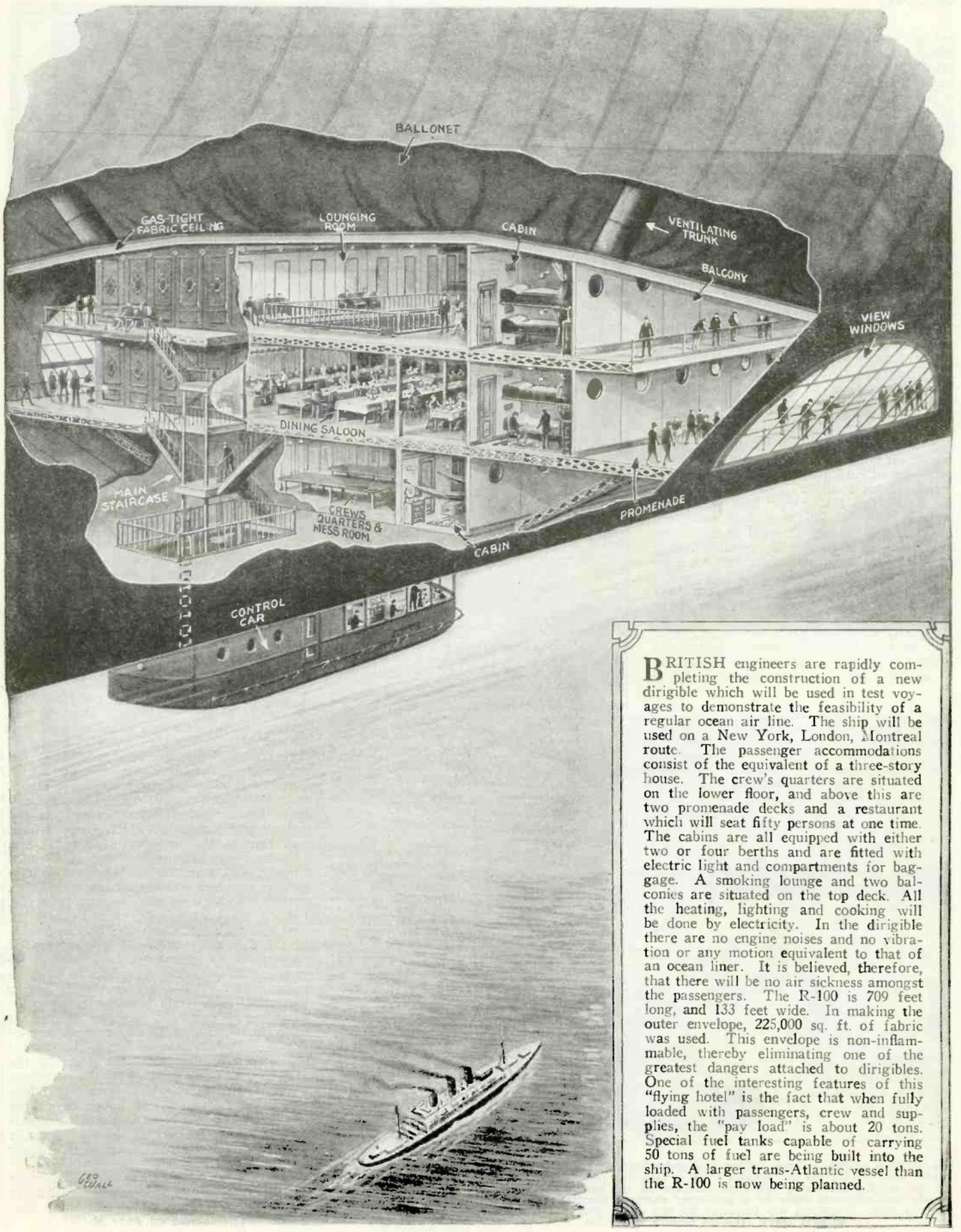
IN some of the testimony regarding the failure of the St. Francis Dam, it was stated that the dam was based on red rock twenty feet below the natural surface of the ground. There are various kinds of red rock, some of which is very soft, and which becomes rapidly honeycombed when placed in contact with water; on the other hand, there are forms of red rock, such as red granite and sandstone, which remains hard and firm in the presence of water. Mr. Charles Petit, County Engineer of Ventura County, California, is quoted in press dispatches as having criticized the foundation rock on which the sides of the great St. Francis Dam were built. Mr. Petit stated that the rock on which the concrete sides of the dam were anchored is composed of decomposed or altered granite, which geologists probably would describe, he said, as mica schist. This engineer stated further that when such strata is subjected to water pressure, it crumbles, and he seemed to think that undoubtedly this is what caused the St. Francis Dam to break, the decomposed rock at the sides, weakened by the water, gave way and then the structure went. Mr. Petit is said to have stated further—that a dam should never have been constructed at this point in the St. Francisquito Canyon, because of the fact that the rock in this section all seems to be largely of the same character.

It was the opinion of one of the hydraulic engineers whom the writer questioned as to the collapse of the St. Francis Dam, that

(*Continued on page* 162)

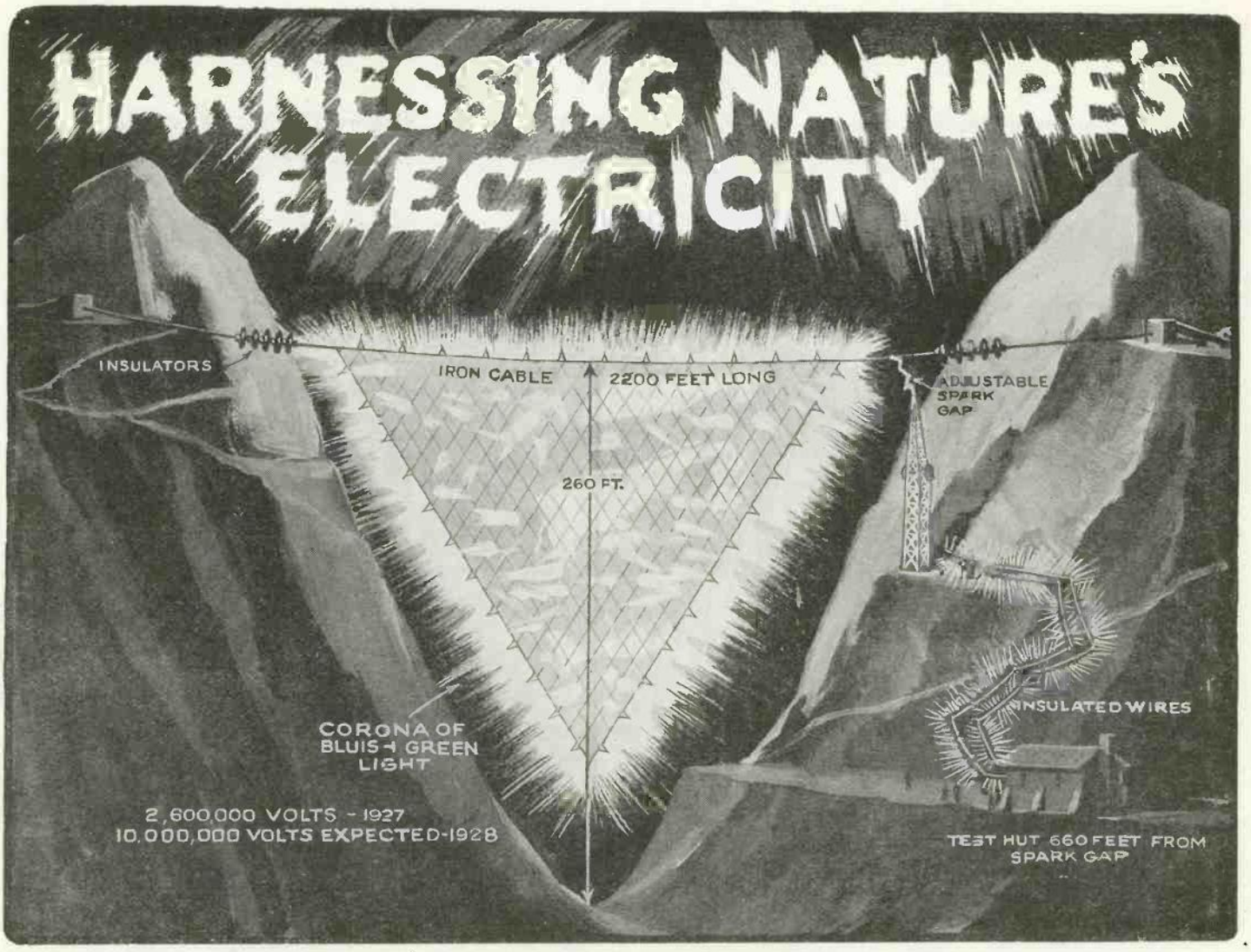
A Trans-Oceanic Dirigible

Huge English Ship Accommodating 100 Passengers Nearing Completion



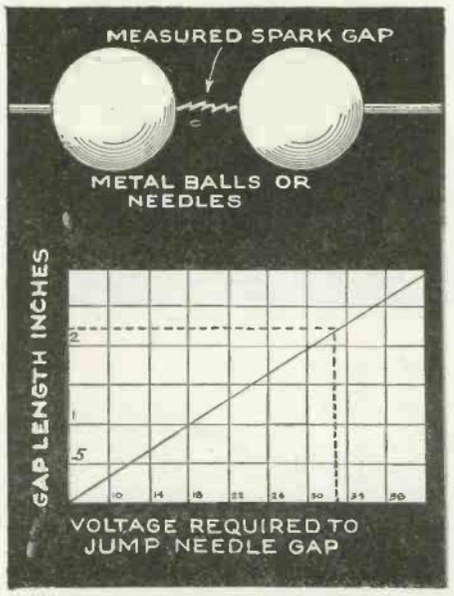
BRITISH engineers are rapidly completing the construction of a new dirigible which will be used in test voyages to demonstrate the feasibility of a regular ocean air line. The ship will be used on a New York, London, Montreal route. The passenger accommodations consist of the equivalent of a three-story house. The crew's quarters are situated on the lower floor, and above this are two promenade decks and a restaurant which will seat fifty persons at one time. The cabins are all equipped with either two or four berths and are fitted with electric light and compartments for baggage. A smoking lounge and two balconies are situated on the top deck. All the heating, lighting and cooking will be done by electricity. In the dirigible there are no engine noises and no vibration or any motion equivalent to that of an ocean liner. It is believed, therefore, that there will be no air sickness amongst the passengers. The R-100 is 709 feet long, and 133 feet wide. In making the outer envelope, 225,000 sq. ft. of fabric was used. This envelope is non-inflammable, thereby eliminating one of the greatest dangers attached to dirigibles. One of the interesting features of this "flying hotel" is the fact that when fully loaded with passengers, crew and supplies, the "pay load" is about 20 tons. Special fuel tanks capable of carrying 50 tons of fuel are being built into the ship. A larger trans-Atlantic vessel than the R-100 is now being planned.

HARNESSING NATURE'S ELECTRICITY



The above scene shows the remarkable electrical effect which frequently occurs in the Alps Mountains, where three young German scientists are endeavoring to extract tremendous electrical discharges from the atmosphere. The idea behind these experiments is that man may find a way to disintegrate the atom, and thus unlock a tremendous new source of energy.

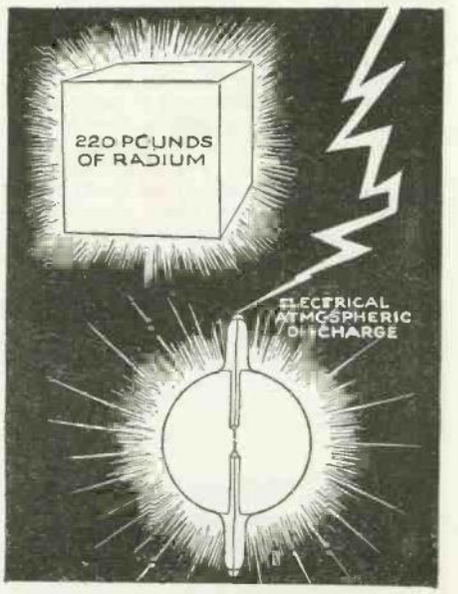
BENJAMIN FRANKLIN, fired the imagination of electrical engineers and experimenters all over the world for a century beyond his time, when on an immortal day he demonstrated by means of his kite, that lightning was a natural electrical phenomenon. Every student of electrical matters has at some time or other dreamed of utilizing the gigantic electrical charges which are ever present in the atmosphere surrounding our earth. Several scientists have lost their lives while trying to harness the tremendous electrical discharges in the form of lightning. Last summer and again this summer, three young German scientists, A. Brasch, F. Lange and C. Urban of the University of Berlin, aided by all the latest scientific information as to how to protect themselves, will attempt to measure and chart the atmospheric electrical discharges high up in the Alps.



Sphere spark gaps, and in some cases needle gaps, of predetermined dimensions are used for measuring high potential discharges. When a discharge jumps a certain length of gap, the voltage is easily read from the calibration chart.

These daring young scientists found in last summer's experiments that electrical sparks of great intensity and accompanied with a roar like that of huge cannon, jumped the gap of their apparatus repeatedly, even when no electrical storms were in the vicinity. On several occasions electrical sparks jumped the large gap on an average of one every second for thirty minutes, and these discharges averaged two million volts. A beautiful corona of bluish-green color played around the cable and wire net at night. The cable and net were suspended across the valley between two peaks in the Alps, as the accompanying pictures show. This corona had all the appearances of the Aurora Borealis, that most magnificent electrical display observable in the arctic regions particularly.

In last year's experiments, the three scientists measured atmospheric discharges having potentials as high as 2,600,000 volts, when the summer electrical storms were practically over; it is hoped this year with the improved apparatus to measure potentials up to ten or more million volts. It is known that potentials of from 5,000,000 up to 30,000,000 volts passes to earth from an



It is hoped by the European investigators that a sufficiently powerful atmospheric electrical discharge can be obtained, which will yield a power equal to the Alpha rays obtained from 220 pounds of radium.

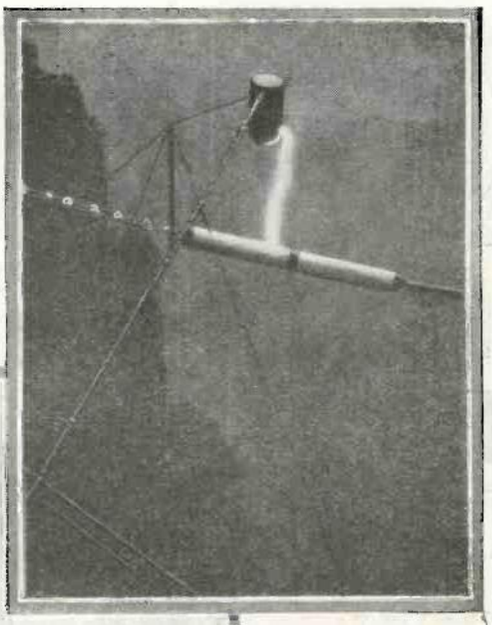
Remarkable European Experiments with Atmospheric Electrical Discharges with Potentials as High as 3,000,000 Volts

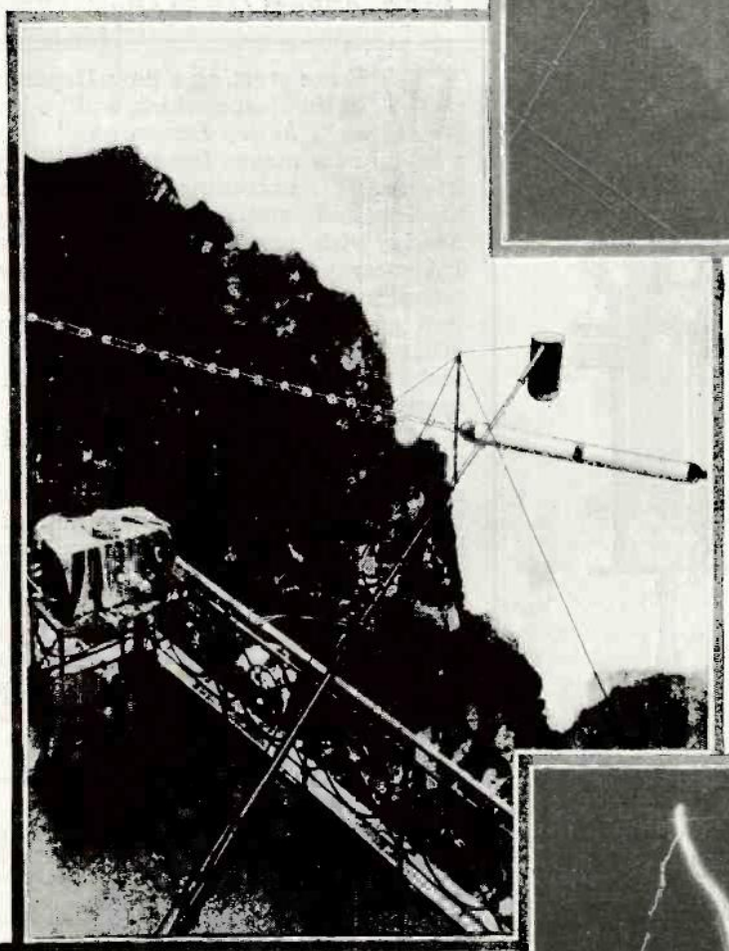
By HENRY TOWNSEND

elevation of 350 ft., and these students of natural electrical phenomena have found a very desirable location in the Alps, where they can suspend between one mountain and an adjacent one, a strong iron cable having a length of about 2,000 ft. This cable is about 250 feet above the intervening valley, and from it these daring engineers have suspended a coarsely woven wire net, which serves as an electrical capacity to gather the electricity from the atmosphere. As shown in the pictures, the wire net is supplied with numerous sharp points to aid in collecting the current from the air.

As the accompanying photographs of the actual apparatus and wire cable used last year clearly show, an adjustable spark gap of considerable length is provided. By adjusting this spark gap to various lengths, it is possible to judge the voltage of the discharge which leaps the gap at any moment. Mr. F. W. Peek, Jr., the well-known American worker in the realm of high voltage measurements, together with other engineers, have provided tabulated data and curves for various lengths of both needle and sphere type spark gaps. As one of the accompanying diagrams shows, it is a simple matter to calculate the voltage when a certain length of gap is used. The engineer first checks the length of the gap on the chart; he then follows a line horizontally from the gap length, to where it intersects with the angular line on the chart; and from the point of intersection he looks in a visual line downward to a place where the voltage is given. For needle spark gap measurements, the characteristic curve on the chart is practically a straight line, while for sphere gaps the characteristic curve on the voltage versus gap length, is a curved line. Those interested in high voltage measurements by means of the spark gap method can find the voltage-gap tables and charts in the *Standardization Rules* of the American Institute of Electrical Engineers. According to Mr. Peek's researches, the voltage per foot of atmospheric electrical discharges is about 100,000, while in laboratory measurements with A.C., transformer high potential discharges, the average voltage per foot of spark was found to be about 150,000 volts. The voltage of a lightning flash may

(*Continued on page* 156)



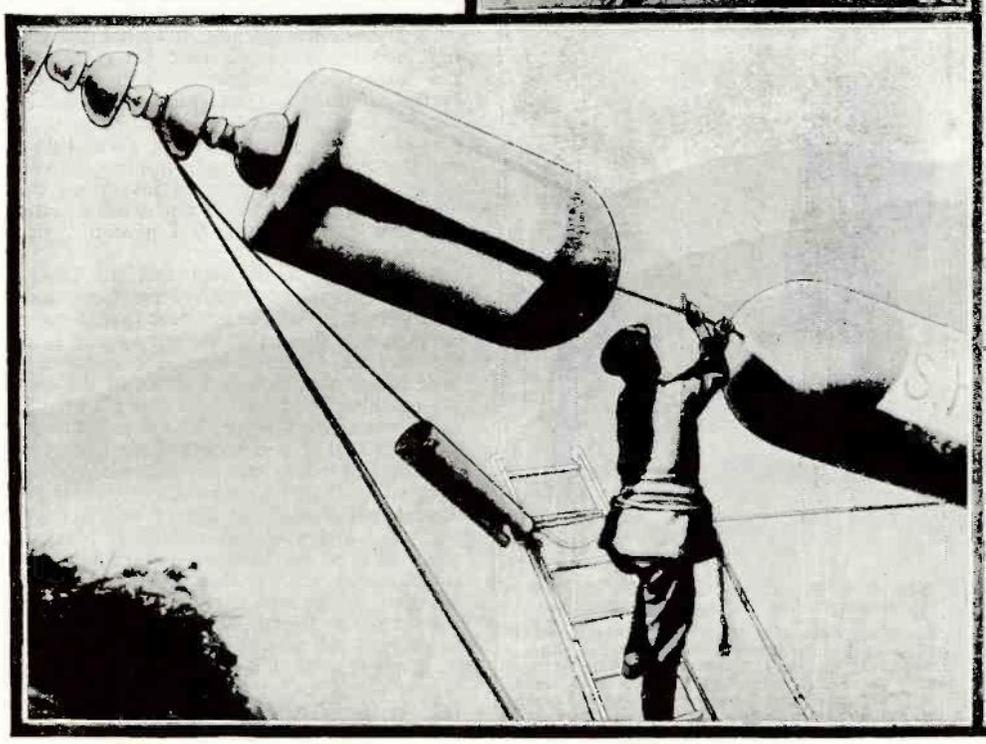


Actual photo above shows 13 ft., heavy spark obtained from the collecting net in the Alps by the German scientists. The voltage is about 2,000,000. The spark occurred once per second for 30 minutes.

Photo, left, shows the adjustable spark gap used in the Alps. Notice the heavy electrode on the end of the adjustable arm to which the spark jumps.

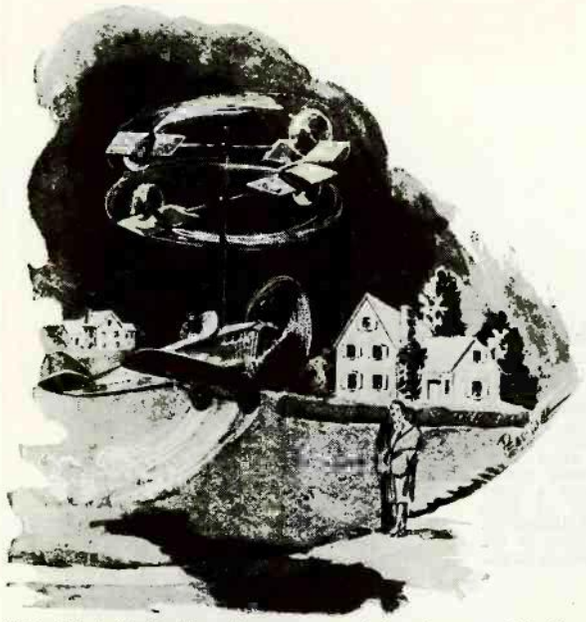
Below we see 3,000,000-volt artificial lightning stroke produced in G. E. Laboratory at Pittsfield, Mass. Note man.

Actual photograph of the experimental "kite" used by the German experimenters in the Alps Mountains, for the purpose of accumulating high potential electrical discharges from the atmosphere. Note the size of the insulators.



Helicopters

New Advances in the Field of Aeronautics Relate to



The above illustration shows a new style of proposed helicopter which has a separate engine in each of the vertically acting foils and also an engine and propeller for propulsion.

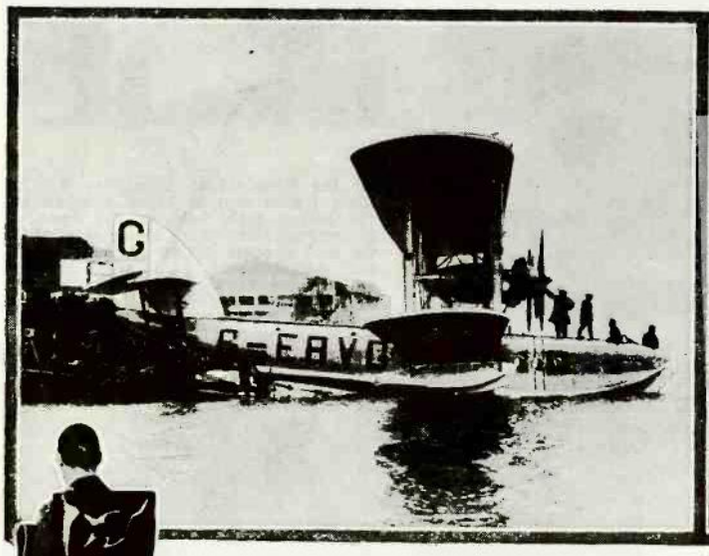
THE world is looking forward to new developments in aircraft, and possibly even getting more than it expects in the way of radical departures from present styles. Aviation enthusiasts believe that the only solution to the problem of popular flying is the development and successful demonstration of vertical flying machines. These machines will have to be able to rise from a limited tract of land and come to rest in the same space. In addition, they will have to proceed at a speed of approximately sixty miles an hour and be absolutely safe, even in the event that the engines should stop.

A prominent eastern aircraft corporation has announced their intention of proceeding to develop the vertical-rising aircraft illustrated on this page. This consists of two air foils or modified propeller blades, mounted at the end of cross arms, and each of the foils is to be provided with its own engine and propeller. These areas are to provide the lift, and they both turn in opposite directions, as the diagram indicates. Instead of tilting the airplane, in the usual method in order to produce a horizontal flight, a propeller and engine for propulsion is provided. The airplane itself will also have a plane surface large enough to permit the craft to glide to the earth, in event of accidental stoppage of any or all of the motors.

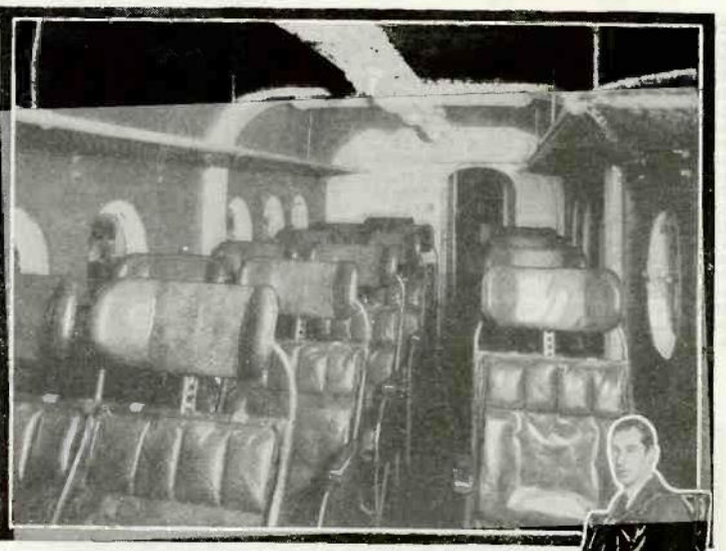
The well known electrical wizard, Dr. Nikola Tesla, has invented a new method of aerial transportation, explained in his patent No. 1,655,113. The details of this are also indicated on these pages. Dr. Tesla states that the helicopter type of flying machine is quite unsuitable for speedy aerial transportation because of the large inclination angle of the propeller axis to the horizontal at which the ordinary types are expected to operate. He further holds that these machines are incapable of proceeding horizontally along a straight line under prevailing air conditions, that they are subject to plunges and oscillations, and almost certain to be doomed to destruction in case the motive power gives out. In his own system, the construction is composed of two planes rigidly joined. The tail is omitted for the sake of smallness and compactness, or if used, is retractable by simple means.

As motive power, Dr. Tesla intends to employ the turbines which he invented some years ago and which were fully described in the July 1920 issue of this publication. When the mechanism is at rest, the planes and the driving propeller will be vertical. The operator or passengers are suspended on trunnions which can turn through an angle of about 90 degrees. The usual devices for lateral and directional control are provided to enable the operator to actuate them by foot or hand.

At the start, sufficient power being turned on, the machine will rise vertically in the air to the desired height. When it is gradually tilted by manipulating the elevated devices and proceeds like an airplane, the load being transferred from the propeller to the foils as the angle of inclination diminishes and the speed in the horizontal direction increases. It will thus be seen that with the tilting of the machine, the operator will increase the thrust of the propeller in order to compensate for the reduction of sustaining force which follows as the plane tilts, and before the reaction of the wings can come into full effect. He then gradually cuts down the motive power as the machine gains in velocity. From this point on, the operator can proceed to his destination and on reaching this, the same mode of bringing the machine to a rest is employed. Here the operator causes the machine to again rise in the air and permits it to gradually settle down, as he decreases the thrust of the propeller or the speed of the engine. It will again be observed that at this point the load is being carried primarily by the propeller.



The photograph above shows a new giant all-metal British seaplane which has just been put into service. It will carry fifteen passengers and their baggage, and is fitted with safety appliances.

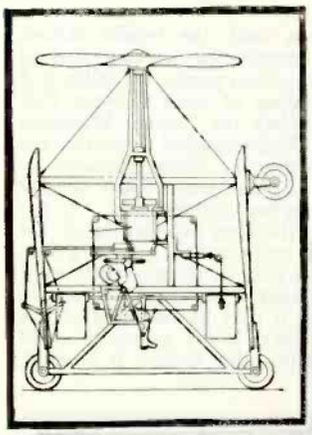


The interior seating arrangement of the new British seaplane. The seats are so arranged that they house both life preservers and parachutes, both of which can be instantly strapped to the occupant.

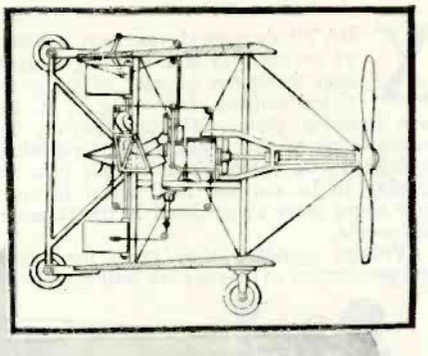
The photographs here show the world's largest seaplane liner. It is equipped with three 485 horsepower Jupiter engines, and is made entirely of metal. It is completely equipped with every convenience for the passengers, including dining and culinary service. The seats are air-filled, and comfortably hold the life belt and parachutes for a forced departure from the plane. The photographs on either side show one of the seats and the equipment strapped to a passenger. The immensity of this plane can be estimated by comparing with the men standing on the vessel.

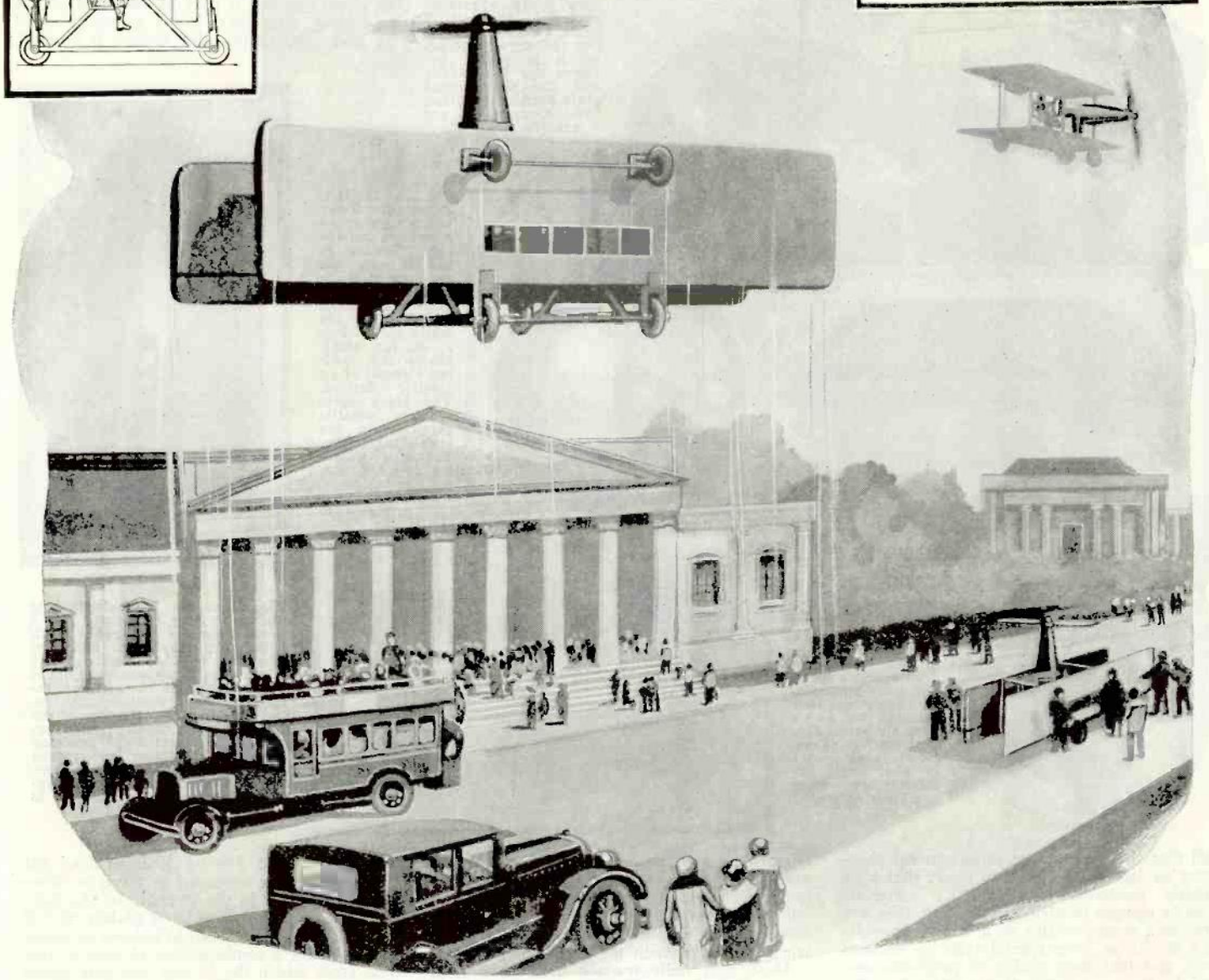
and Safety Planes

Making Flying Safer and Toward the Development of Vertically Rising Machines.



Below is an artist's conception of the vertically-rising helicopter invented by Dr. Nikola Tesla as it would appear in flight, at rest, and taking off. At the left are the details of the mechanism as it would appear when an aviator attempts to arise or alight. Speeding up the propeller and tilting the plane, he assumes the position indicated at the right and proceeds along his flight.



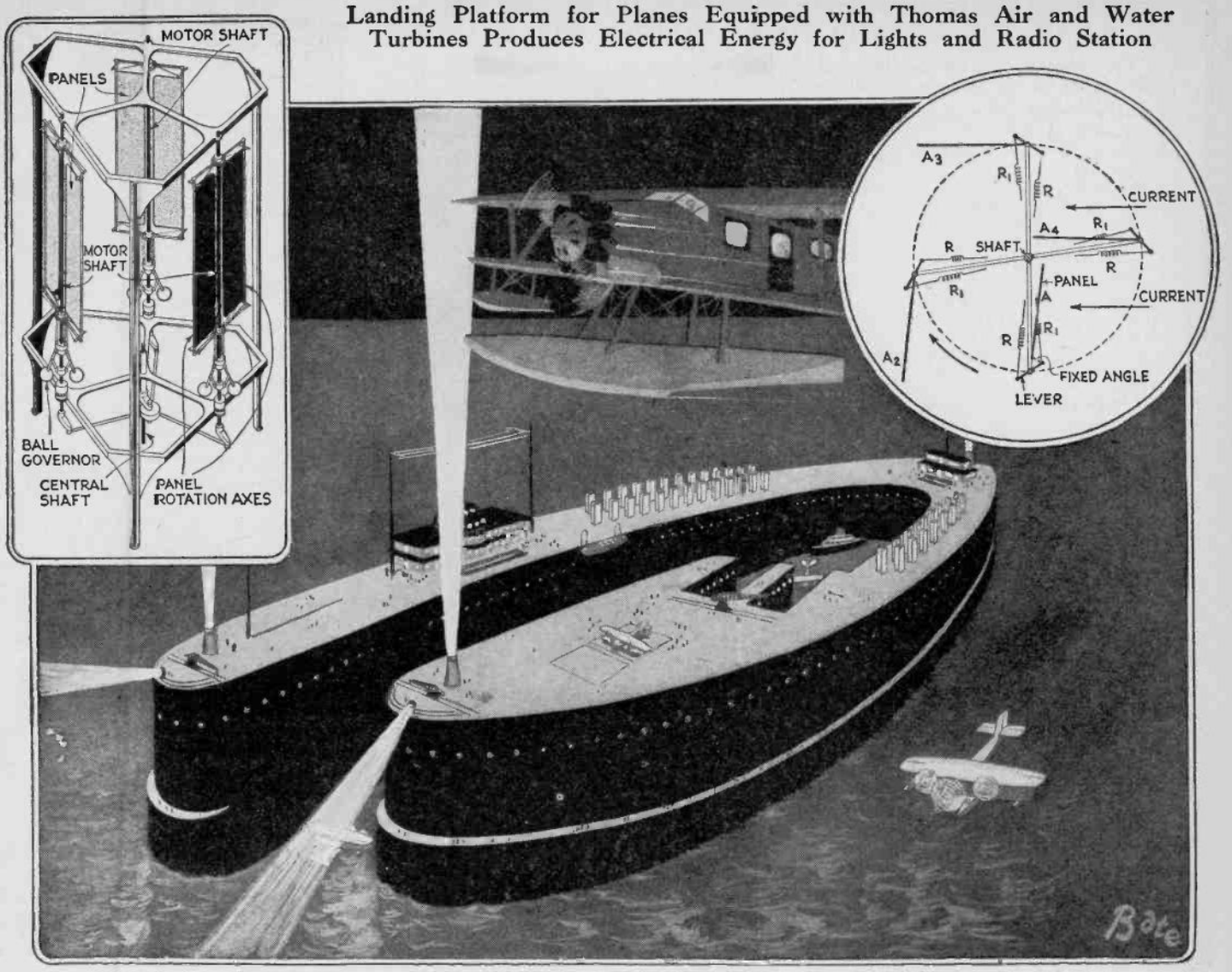


It will be observed that any type of a gasoline engine could be employed in a helicopter of this nature, but Dr. Tesla recommends the use of his gasoline turbine because of its lightness and because it lends itself to this kind of work, for which the modern types of engines might be unsuited. His own turbine is capable of carrying a great overload and of running without danger at excessive speeds so that during the starting and landing operations, the necessary power can be developed by the motors. At the same time there is always a surplus of power which can be employed if the operator desires to greatly increase his forward speed. The illustrations on this page show the machine as it would appear at rest, with the propeller in a vertical position and the same plane in horizontal flight. No tail is here indicated, but if one were to be employed, it would as mentioned before, be quickly retractable.

And in London, developments along the line of passenger aircraft are rapidly proceeding, with every safety appliance imaginable being included and everything being done to accommodate the passengers. In these large planes the seats are now fully equipped with both parachutes and life preservers, so that in the event the passengers have to leave the plane because of an emergency, they can step out of it, even while it is in flight and negotiate a perfectly safe landing. These planes are all-metal built.

The ability of metal planes in carrying out successful long distance flights is exemplified by the German plane the "Bremen," the first to cross the Atlantic from east to west. The flight was from Dublin, Ireland to Greenely Island, Canada, with Baron von Huenefeld, Herman Koehl, and James Fitzmaurice.

Landing Platform for Planes Equipped with Thomas Air and Water Turbines Produces Electrical Energy for Lights and Radio Station



The above illustration shows a proposed ocean landing platform for airplanes. The wind turbines may be seen.

A top view and a side view showing the construction of the generator turbines appear in the insets.

MID-OCEAN AIRPLANE STATION GENERATES OWN POWER

THE invention of the Thomas wind and water turbine opens up a new field for the development of natural power. Boats equipped with these turbines are enabled to generate their own power, resulting in a saving of money, besides simplifying the installation of propelling mediums. The same turbines can be used on land for generating electrictiy at an extremely low cost.

A mid-ocean landing platform for aircraft using the new invention has been proposed by the French magazine *La Science et La Vie*. This seadrome is shown in the illustration and generates its own electric power for operating the searchlights, landing lights and the radio station, which may be seen on the left-hand section of this peculiarly shaped floating haven for aircraft. The land planes will alight on and take off from the largest section of the "U" shaped float. The water enclosed by the floating airdrome provides a harbor for the seaplanes. Life boats are arranged at intervals along the landing platform and the interior provides ample housing space for mechanics, gasoline, water and spare parts. Trans-oceanic planes will refuel and make repairs at the mid-ocean platform. Passengers and mail could also be transferred from one plane to another. By means of powerful searchlights and neon beacons, the platform will be visible to aviators even in the most foggy weather, and will offer a haven where they can repair until storms have abated. For shelter, the planes could be lowered into the interior of the platform, or suitable hangars could be arranged upon the upper deck.

The construction of the Thomas turbine which makes this mid-ocean landing stage possible is shown in the smaller illustrations. A vertical shaft is fixed in the center of a rigid frame which can be of steel or reinforced concrete. This shaft carries two rectangular frames whose horizontal arms are fastened to the shaft by means of sleeves. The vertical members of these rectangles are formed by tubes which can turn on their own centers. Each of these tubes carries a wing or sail which is free to turn in or outside of the frame. The extent of motion is limited by two springs, R and R_1. Both are attached to the lower sleeve of the main shaft, prolonged by two cables which pass over two pulleys on the upper sleeve which carry them to the two extensions of a sort of lever arm, the latter fastened to the vertical tube which carries the sail or wing.

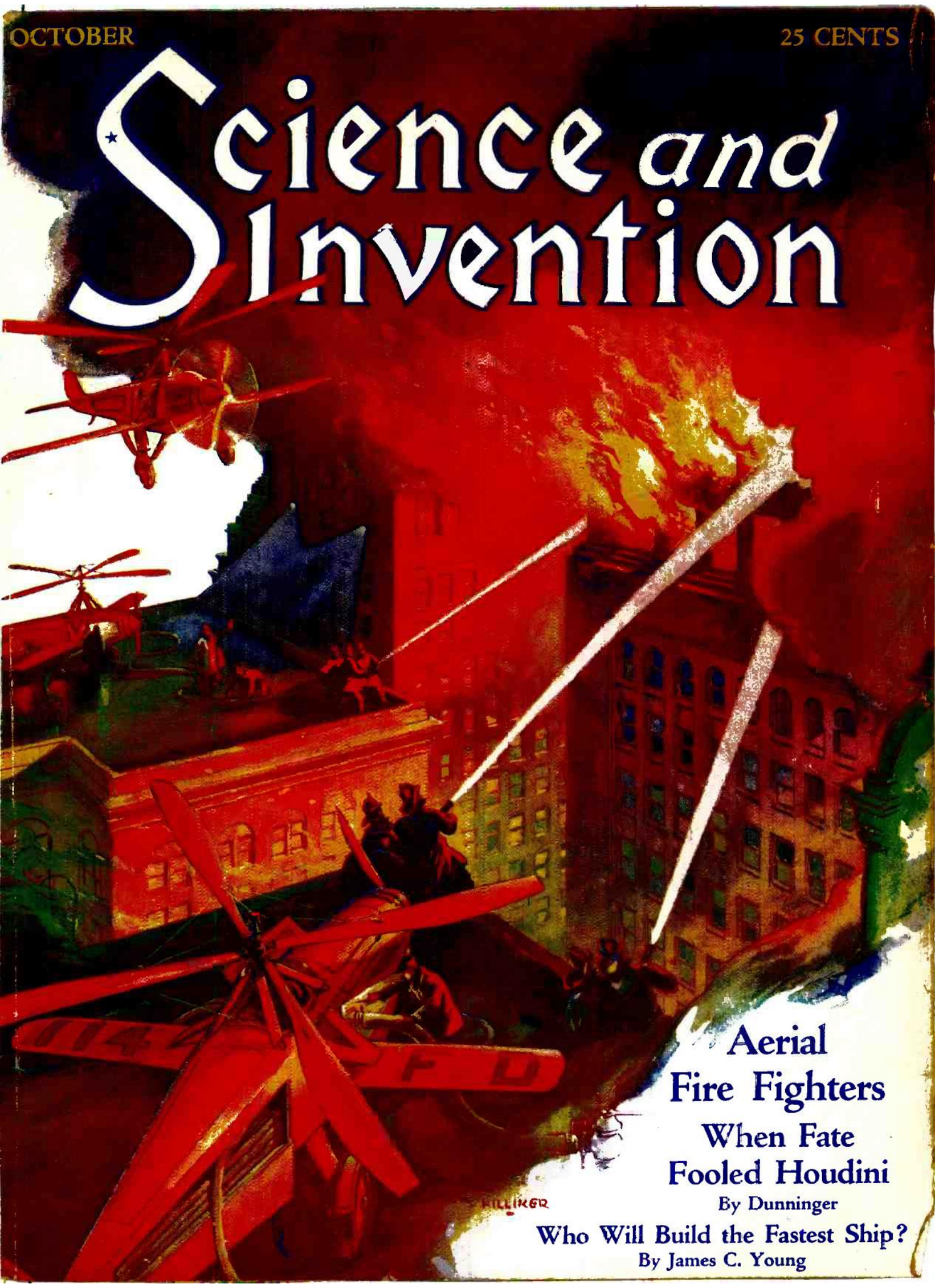
When the wing occupies position A, the impulse due to the current which may be wind or flowing water is at its maximum. The spring R is completely stretched while the spring R_1 is completely slacked. This position is brought about by the maximum tension of the spring R_1, so that the angle made by the sail and lever arm has a fixed value. At this instant, the opposite arm A_3 has a position sensibly parallel with the current. Each sail works through an arc of 270 degrees, so that there is only 90 degrees of useless rotation and, as the turbine carries at least two sails, forming an angle between them of 280 degrees, there is a constant force exerted, whatever the wind direction.

www.americanradiohistory.com

OCTOBER

25 CENTS

Science and Invention



Aerial Fire Fighters

When Fate Fooled Houdini

By Dunninger

Who Will Build the Fastest Ship?

By James C. Young

Aerial Fire Fighters

How Airplanes Will Increase Speed and Efficiency in the Operation of Fire Departments

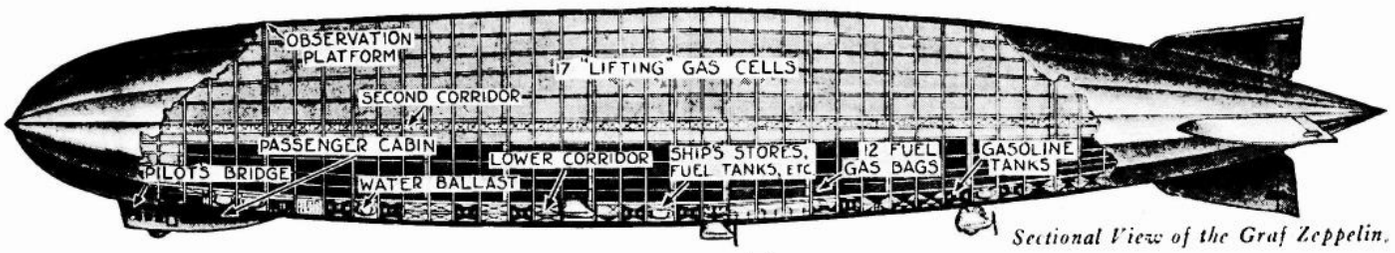
By John Croller

The illustration above and at right shows how the aerial fire-fighting planes would attack a skyscraper fire. The plane would fly to the scene of the conflagration and land on the roof of the nearest building. The suction hose will be attached to the building's standpipe and one or more hoses attached to the delivery pipe of the pump, the pump acting as a "booster" and serving to throw streams of water several hundred feet beyond the range ordinarily possible.

OUR front cover and the accompanying illustration also illustrate the very latest idea for fighting fires with the aid of airplanes. The airplane shown in the accompanying picture is a special new form of plane, known as the *autogiro*. The outstanding feature of this new type of aircraft is that it can ascend or descend almost vertically on the order of a helicopter. One of our leading fire-fighting experts, a member of the New York City Fire Department, recently declared that the city is on the verge of adopting the airplane as a part of its regular fire-fighting equipment.

The accompanying picture shows how the autogiro form of plane could be arranged to carry hose, as well as a fire pump and accommodations for several firemen. A special clutch would permit the airplane engine to be connected with the water pump, this pump taking water from a standpipe terminating at the building roof. Where insufficient pressure of water was available to fight fires in tall buildings in the vicinity, the pump on the airplane would act as a booster and enable the firemen to direct streams of water into much higher buildings in the vicinity. Another distinct advantage of the airplane as one of the important links in our modern fire-fighting equipment lies in its great speed. Imagine how much faster a fleet of fire-fighting planes could travel several miles to a large conflagration compared to a number of automobile fire engines making their way through the crowded streets of a large city like New York or Chicago. These fire-fighting planes would carry, in addition to hose and pump, a goodly number of hand-operated portable fire extinguishers, axes, scaling ladders and other equipment which readily permits its crew of firemen to put out any ordinary blaze. The cost of these fire-fighting planes would be quite reasonable, considering the great advantage of speed with which these planes could travel to a fire. These planes can also land on the water, if they are designed as amphibians, and in this capacity they will prove invaluable.

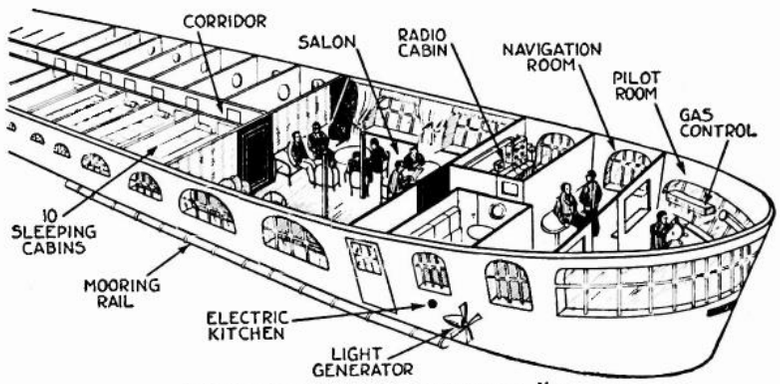
In fact it would not be unreasonable to assume that in ten to fifteen years from now a major part of our fire-fighting equipment may have "sprouted wings." As our cities keep expanding and our suburban sections multiplying, the principal desideratum will be speed, and the airplane seems to be the best answer to that problem. For the small town fire-fighting equipment, the airplane will soon prove indispensable.



Sectional View of the Graf Zeppelin.

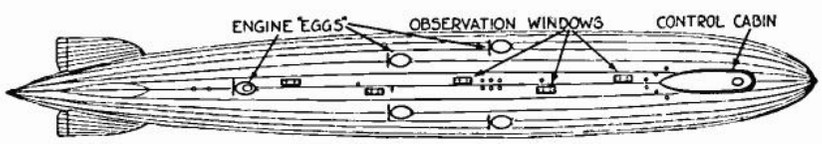
INSIDE THE Graf Zeppelin

THE sectional view of the *Graf Zeppelin*, shown herewith, gives some idea of the complicated internal structure of this large "grown-up" balloon, which carries two kinds of gas, hydrogen for lifting her huge bulk and Blau gas as fuel for her five Maybach engines. Gasoline is also carried as auxiliary fuel for the engines, but only a small quantity of this fuel is carried. A simple valve enables the engineers to instantly switch the engines from Blau gas fuel to gasoline, and vice versa. The Blau gas is carried in twelve bags along the bottom of the frame, just under the hydrogen "lifting" cells or bags. The *Graf Zeppelin* carried 22 passengers and a crew of 40 men, including three pilots and three navigators, when she left Lakehurst, August 8.



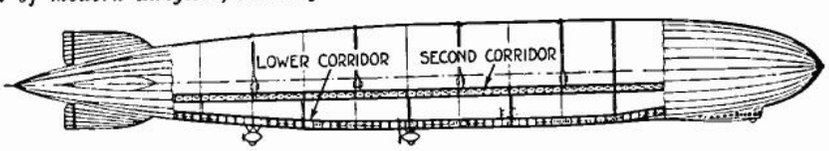
Where the officers and passengers live.

The passenger cabins, dining salon, radio room as well as the "bridge" are shown above. In stormy weather the commanding officer spends many hours on constant watch, together with his officers, at this important key position on the dirigible, where mechanical and electrical means are provided for opening and closing gas valves, ballast dumps, etc.

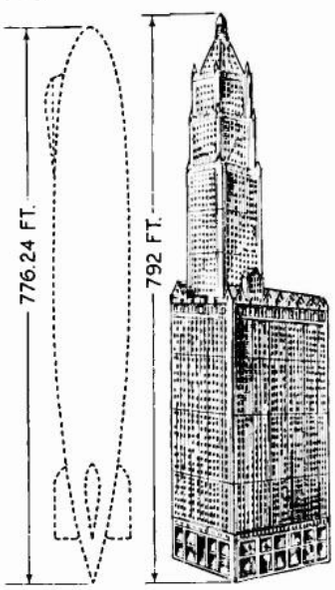


Unusual "bottom" view of modern dirigible, showing windows.

How the bottom of a modern dirigible such as the *Graf Zeppelin* looks is illustrated above; note trapdoor for lowering ropes and also the observation windows.



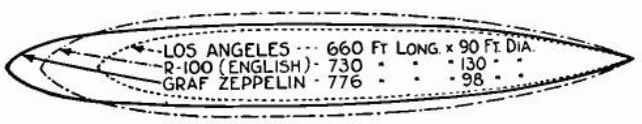
Note second corridor in Graf Zeppelin, for inspection purposes.



Graf Zep compared to Woolworth Building.

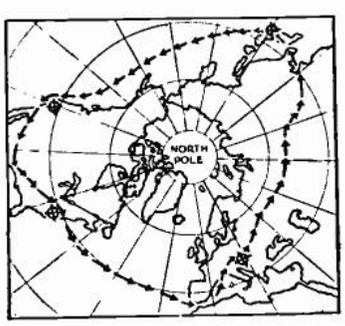
To inspect the 17 "lifting gas" cells, also the 12 fuel gas bags, the designers of the *Graf* provided a lower and a second corridor or catwalk.

If you saw the *Graf Zeppelin* stood up on its tail alongside the Woolworth Building, it would reach nearly up to the dome of that famous edifice. Imagine the bending and twisting stresses in a "balloon" of this size.



Los Angeles, R-100 and Graf Zeppelin compared as to size.

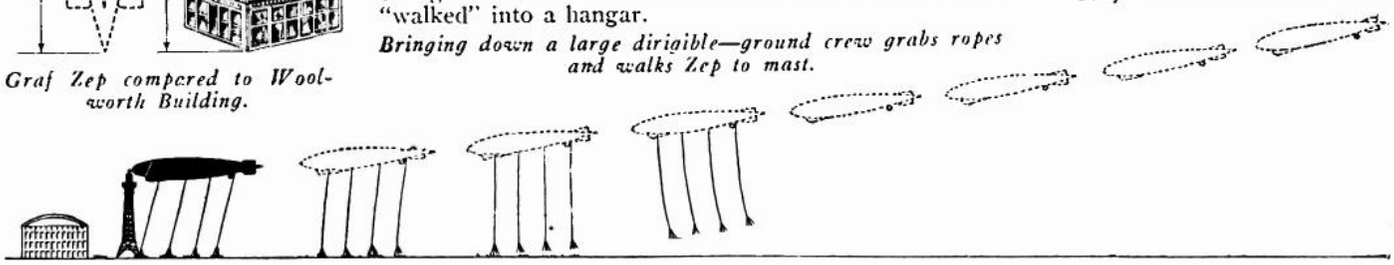
Round-the-world map at right shows path of *Graf Zeppelin* on her 25,000-mile air journey, on which she will make stops only at Friedrichshafen, Tokio, Los Angeles, and Lakehurst.



Graf's round-the-world route.

LANDING of a large dirigible such as the *Los Angeles* or the *Graf Zeppelin* is carried out as shown below. The airship steers downward under her own engine power and drops ropes down. When low enough, the ground crew grabs the ropes and pulls her down low enough to anchor on a mast, or still lower, when she is "walked" into a hangar.

Bringing down a large dirigible—ground crew grabs ropes and walks Zep to mast.



NOVEMBER

25 CENTS

Science and Invention

RAILWAY TO AIRWAY

Are Oil Burners Practical for the Home?

Sky-Hooks for Airplanes

When Inventors Become Air-Minded

Is Mediumship Based on Science?

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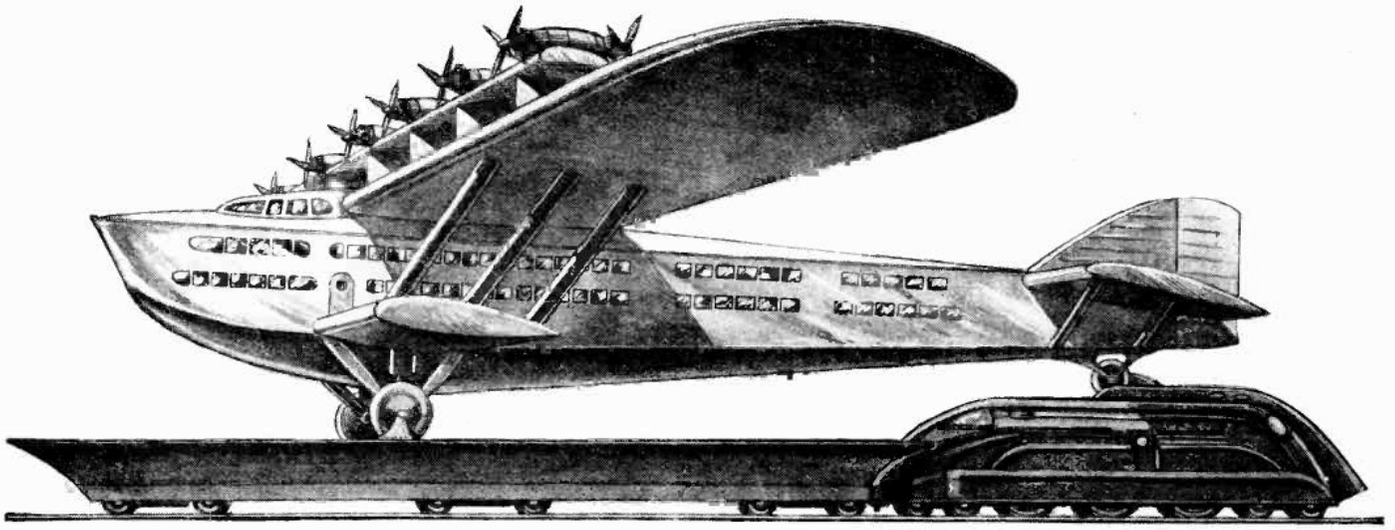
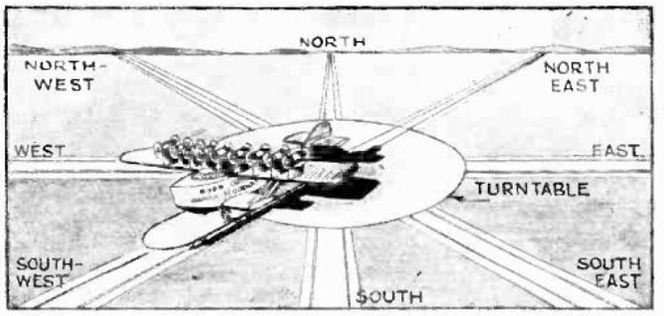


Side view of huge electric engine for launching giant planes.

Railway to AIRWAY

Hurling Giant Planes Into the Air With Huge Locomotives

By Harold Donitz

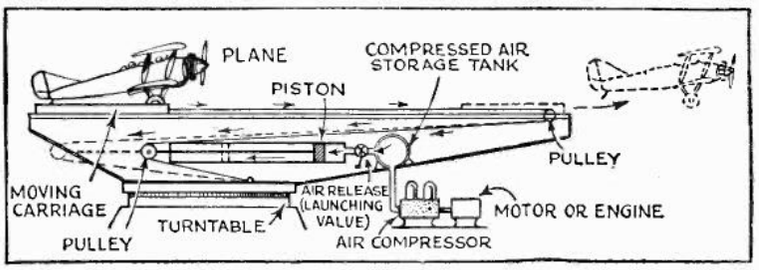


Above we see motor-operated turn-table, together with tracks facing in various directions of the compass, thus enabling the pilot to take off into the wind at any time of the day or night.

COLONEL JAMES FITZ-MAURICE was recently credited with the opinion that the future transatlantic air commerce would be served by gigantic flying boats, and that while these usually take off from the surface of a bay or lake, it was not unlikely that some means would be devised to launch them from the platform of a railroad car. Clarence Chamberlin, famous American flier, stated in a letter to the author that the idea seemed entirely practical for heavily loaded planes about to start on long flights.

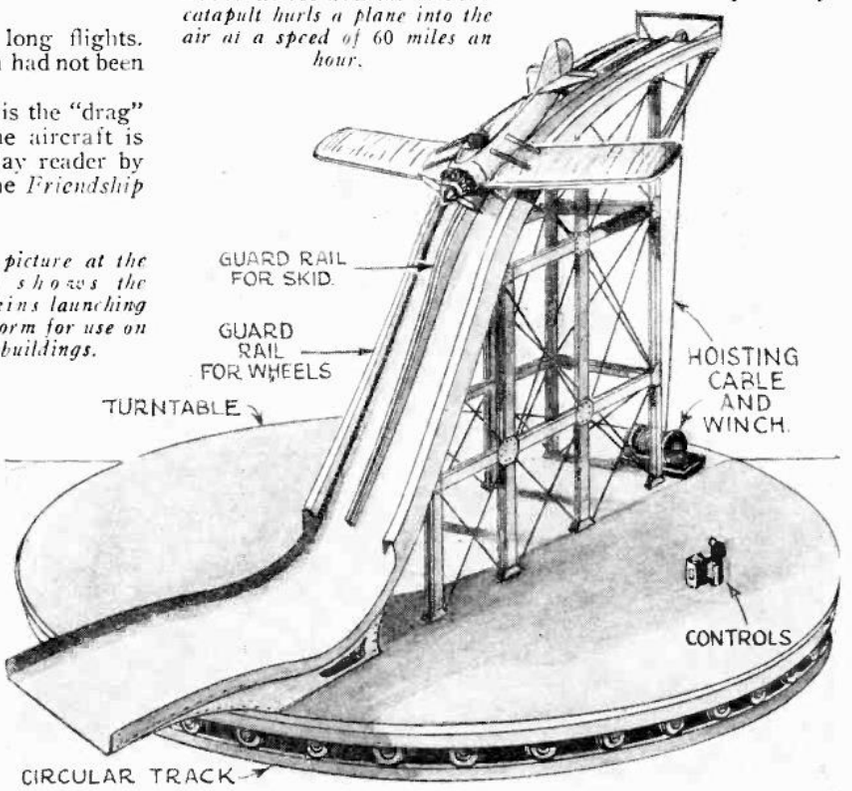
To the best of our knowledge, this proposition had not been voiced before and has not been stressed since.

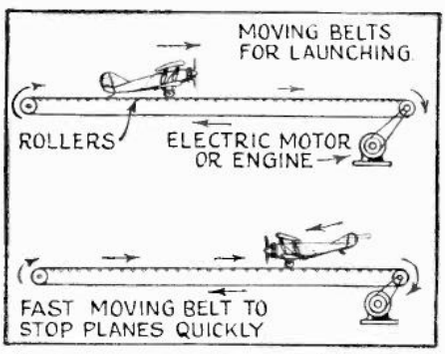
One of the greatest difficulties of flying boats is the "drag" exerted by even the smoothest water when the aircraft is taking off. This drag was manifested to the lay reader by the many futile attempts to take off made by the *Friendship* before its transatlantic hop. Indeed, the drag was only overcome after the weight of the plane had been lessened by reducing (*Continued on page* 640)



Above we see how the modern catapult hurls a plane into the air at a speed of 60 miles an hour.

The picture at the right shows the Jenkins launching platform for use on buildings.





Moving belts operating in a similar manner to the tread on the old "horsepower" machines may be very well put to work for the launching and landing of aircraft, as shown in the diagram above.

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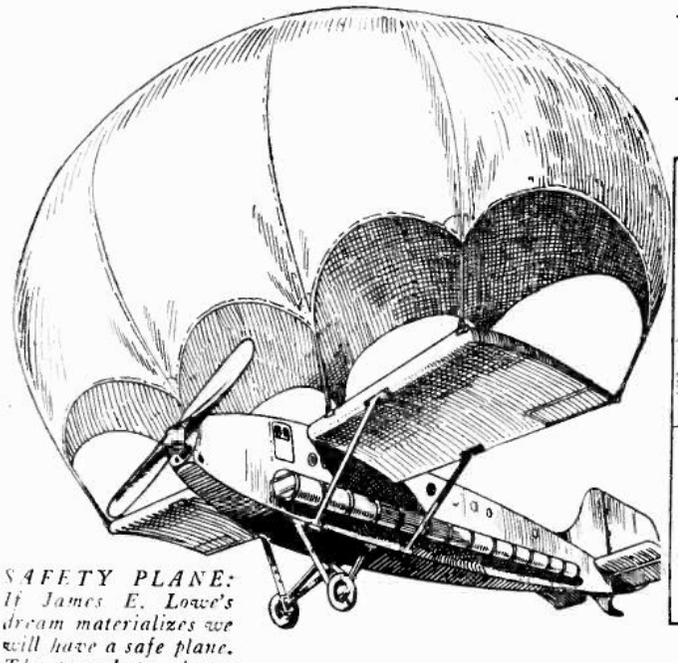
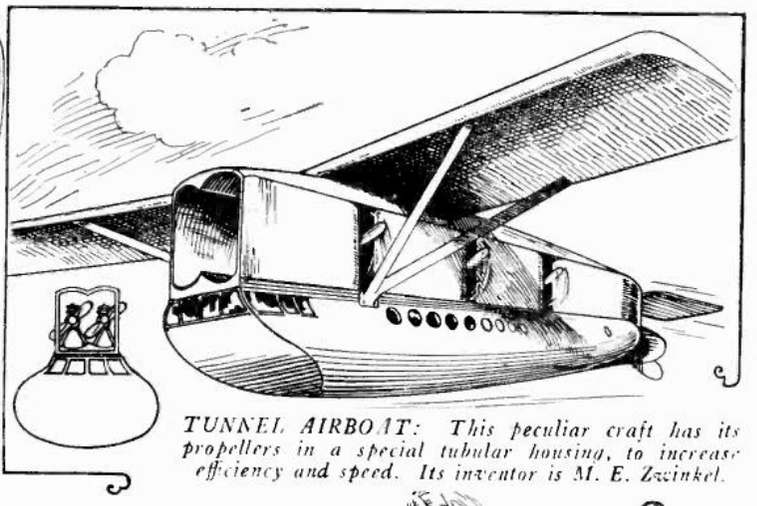
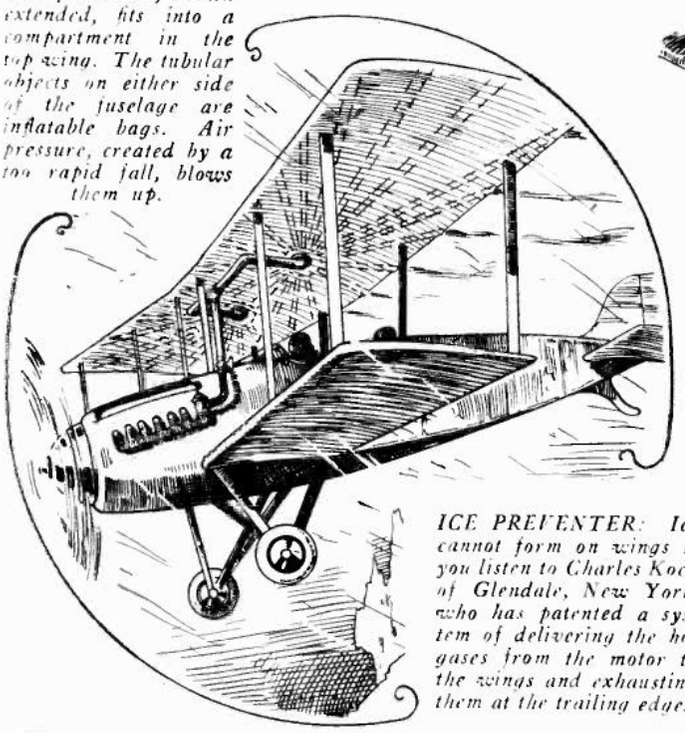
New Aviation



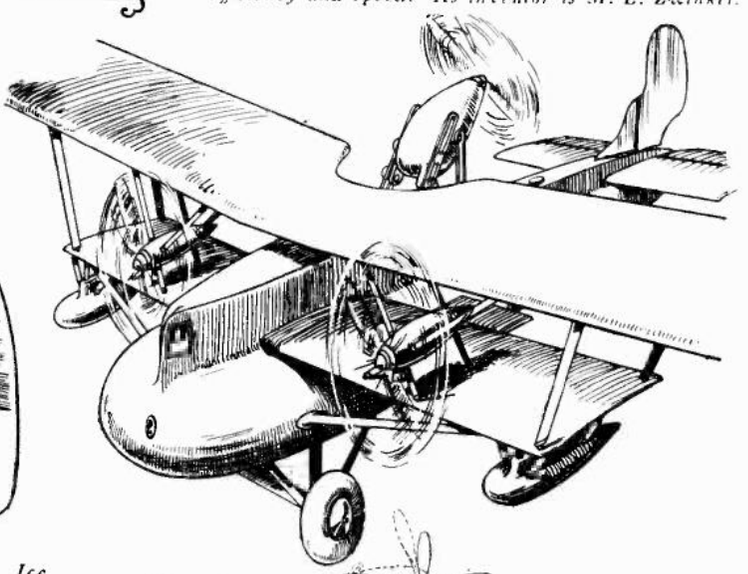
SAFETY PLANE: If James E. Lowe's dream materializes we will have a safe plane. The parachute, shown extended, fits into a compartment in the top wing. The tubular objects on either side of the fuselage are inflatable bags. Air pressure, created by a too rapid fall, blows them up.

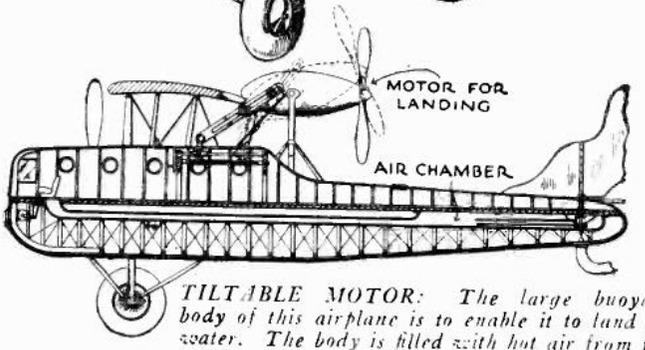


TUNNEL AIRBOAT: This peculiar craft has its propellers in a special tubular housing, to increase efficiency and speed. Its inventor is M. E. Zwinkel.

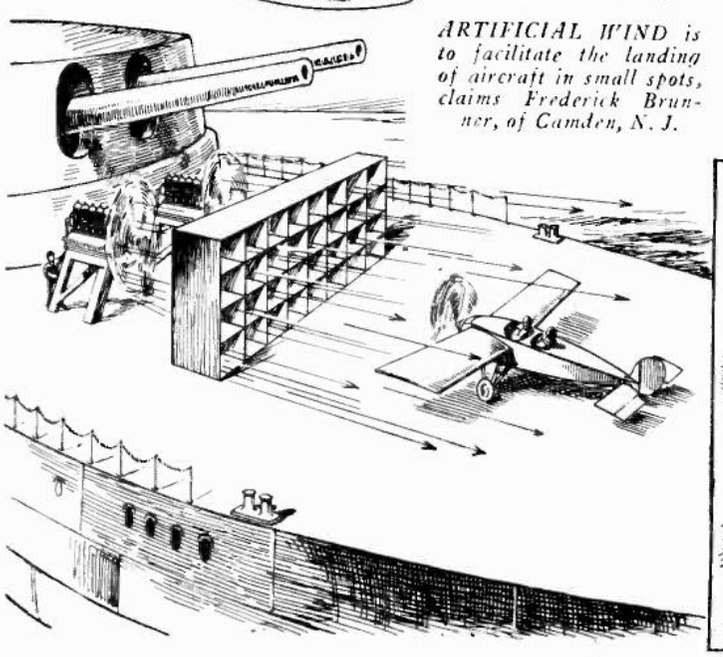


ICE PREVENTER: Ice cannot form on wings if you listen to Charles Koch of Glendale, New York, who has patented a system of delivering the hot gases from the motor to the wings and exhausting them at the trailing edges.

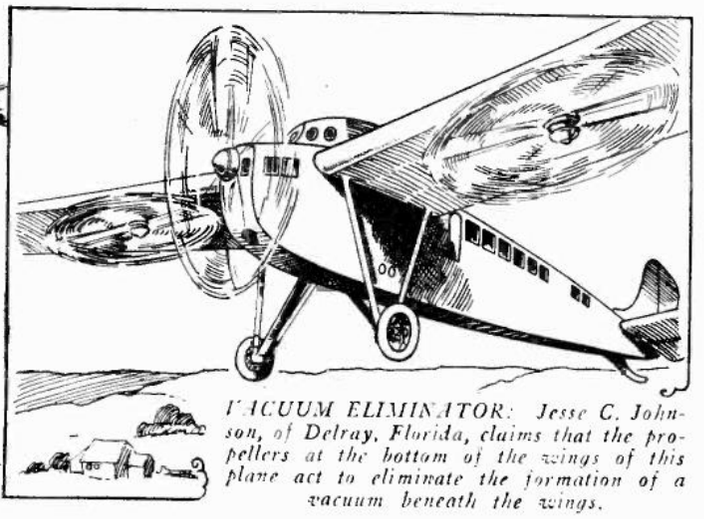




TILTABLE MOTOR: The large buoyant body of this airplane is to enable it to land on water. The body is filled with hot air from the engine exhaust. Giuseppe Cannistra suggests that the tiltable motor be used for landing.



ARTIFICIAL WIND is to facilitate the landing of aircraft in small spots, claims Frederick Brunner, of Camden, N. J.



VACUUM ELIMINATOR: Jesse C. Johnson, of Delray, Florida, claims that the propellers at the bottom of the wings of this plane act to eliminate the formation of a vacuum beneath the wings.

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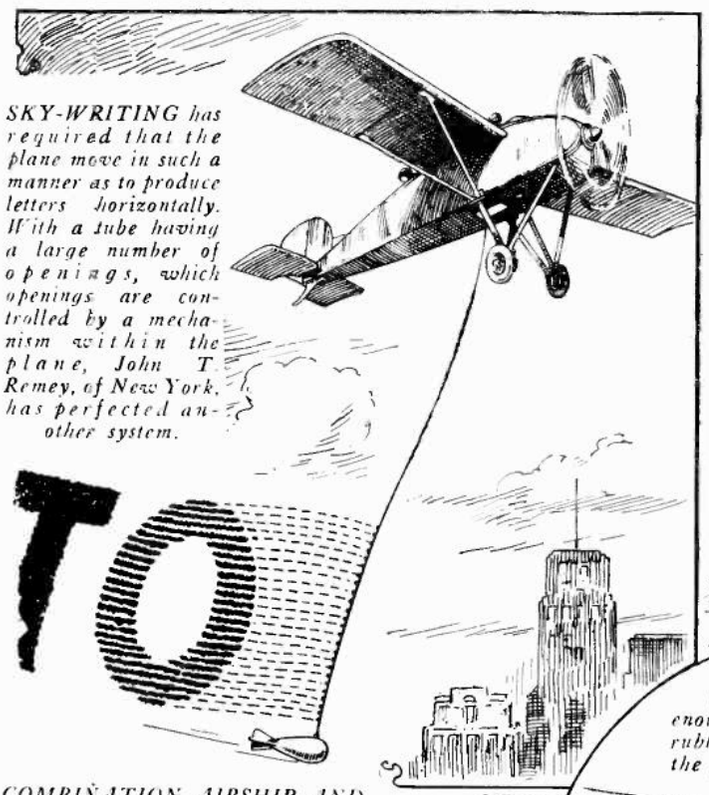
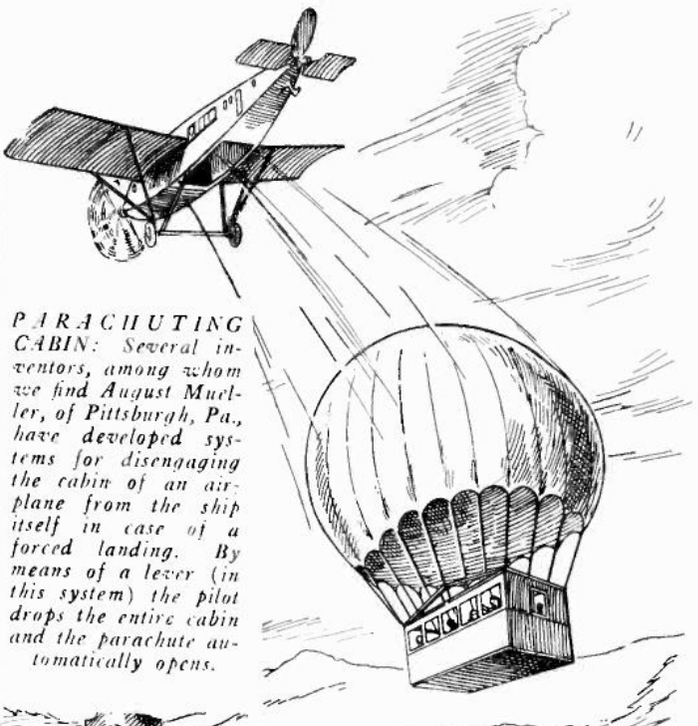
Inventions



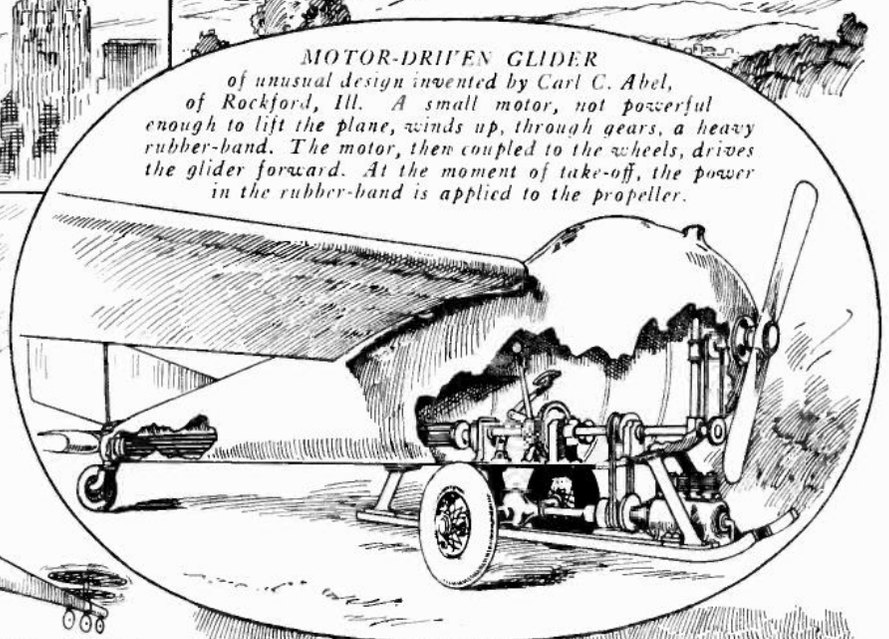
SKY-WRITING has required that the plane move in such a manner as to produce letters horizontally. With a tube having a large number of openings, which openings are controlled by a mechanism within the plane, John T. Remey, of New York, has perfected another system.

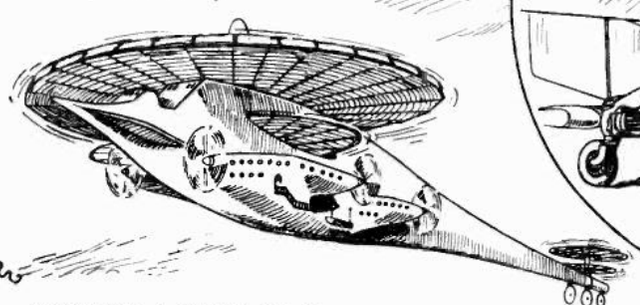


PARACHUTING CABIN: Several inventors, among whom we find August Mueller, of Pittsburgh, Pa., have developed systems for disengaging the cabin of an airplane from the ship itself in case of a forced landing. By means of a lever (in this system) the pilot drops the entire cabin and the parachute automatically opens.

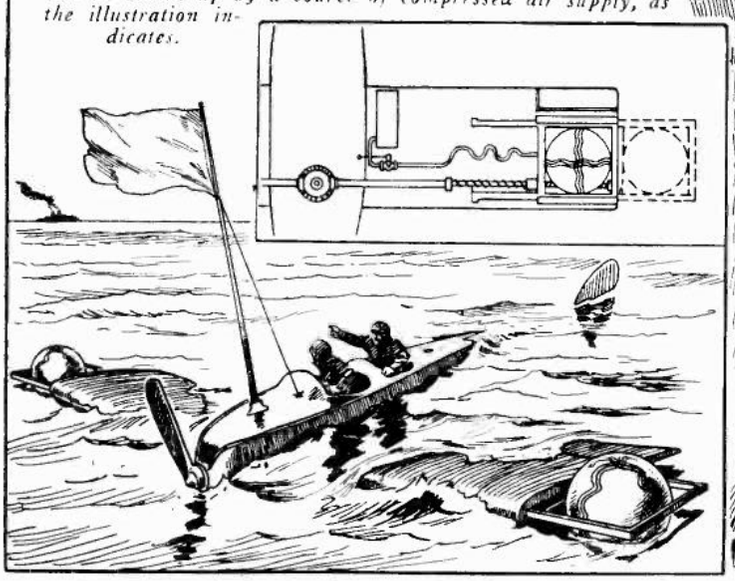
COMBINATION AIRSHIP AND DIRIGIBLE has large rotating disc-like air foils, filled with hot gases; its bird-like body is also so filled. Its inventor is Guido Tallei, of Rome, Italy.

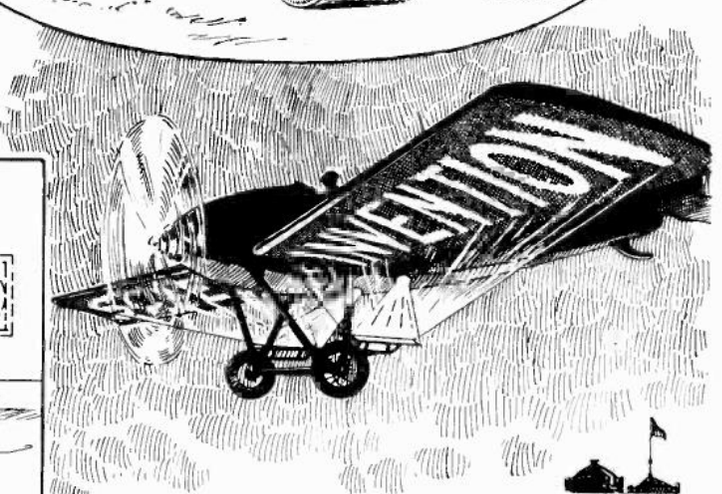
MOTOR-DRIVEN GLIDER of unusual design invented by Carl C. Abel, of Rockford, Ill. A small motor, not powerful enough to lift the plane, winds up, through gears, a heavy rubber-band. The motor, then coupled to the wheels, drives the glider forward. At the moment of take-off, the power in the rubber-band is applied to the propeller.





ANOTHER SAFETY PLANE for oceanic flights, patented by Domenico Pallaria, of London, Ont., Canada, each wing being fitted with a slide, housing an inflatable ball. These can be blown up by a source of compressed air supply, as the illustration indicates.





LIGHTED WINGS: We wonder why this idea was not patented heretofore. Dr. Hugo Junkers, famous German airplane designer, makes the arrangement of two mirrors and two projectors a claim for a patent. The projectors throw a beam of light on mirrors, thence to the under-wing surfaces.

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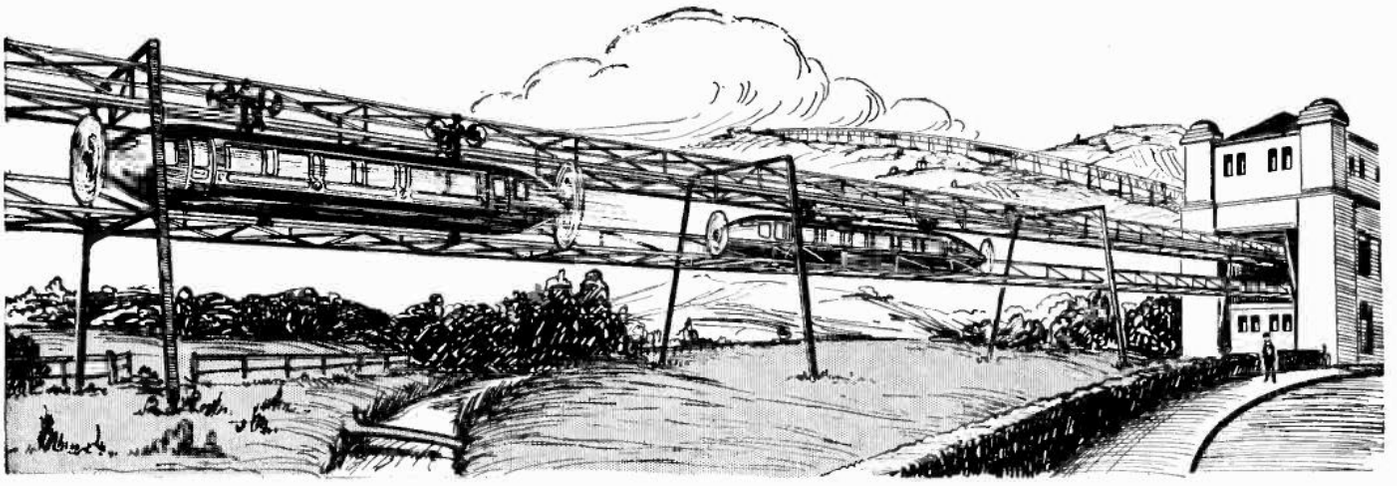
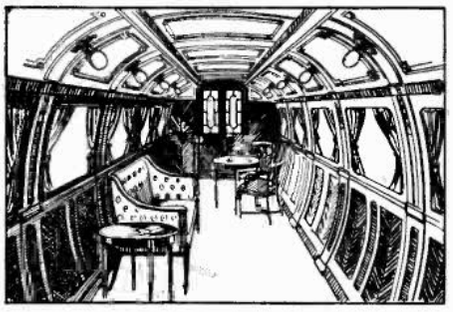


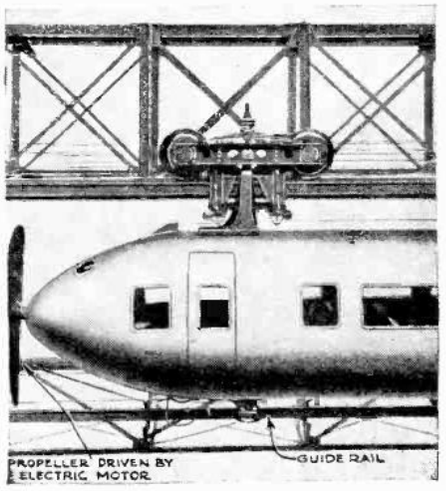
Railway Cars Take Wings



Interior view of the saloon of one of the railplane cars, showing a sumptuousness equal to a transatlantic ship's saloon.

A RAILWAY system with cars that will travel at speeds of 120 miles an hour is now being constructed for test purposes over a tract of the London and North Eastern Railway Company at Milngavie, near Glasgow. The cars of this system will be of light airplane type of construction and will be suspended from single overhead tracks. They will receive their motive power from airplane propellers. The design of the cars may be such that at high speeds they tend to rise slightly in the air, on the principle of an airplane, and thus relieve to a great extent the friction due to the weight of the car.

The overhead tracks are carried on trestles or columns placed at suitable intervals, and a rigid guide rail is provided under each car, to prevent undue swaying of the car. The design of the cars is such that their tendency to rise in the air beyond the amount required to relieve the weight is checked.



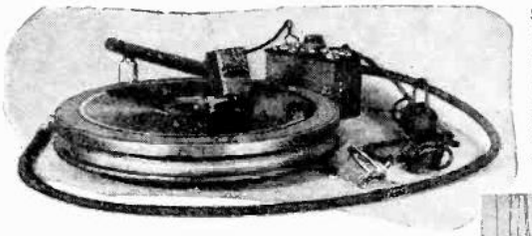
Fresh Sea Air Without a Fan

IN place of fans in the staterooms of the Ile de France, there are ventilating ducts as shown. Fresh cool sea air is distributed from a centralized ventilating system.

The arrow points to the outlet on the wall of the stateroom. The direction of the breeze may be changed by turning the nozzle.

Make Your Home Movies Talk

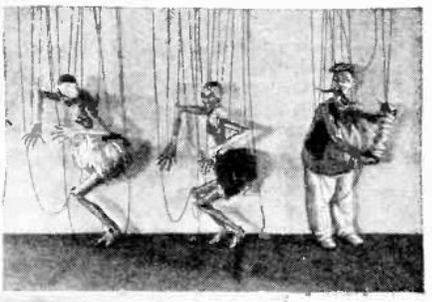
By Don Bennett

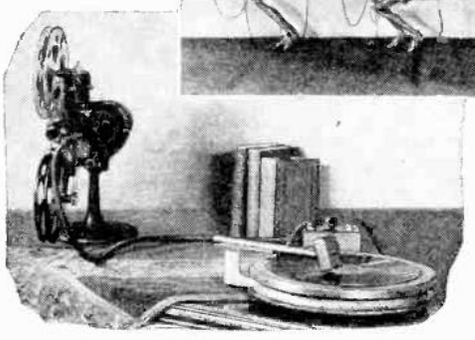


A NEW device has made its appearance in the home movie field that gives promise of increasing the entertainment of home movies. This device provides for the reproduction of talking pictures, such as are run in the theatres, in the home through the medium of the home projector, to which it is attached, and the radio set.

The device resembles a phonograph, with its turntable and electric pick-up, but it is connected to the home projector, regardless of type or make, by a flexible shaft and derives its power from the projector motor. It can be used as a phonograph without the pictures, running either kind of record.

The turntable is rotated by a friction wheel which is located under it. The speed is adjusted by sliding the friction wheel radially along its shaft. A gauge is provided so that the wheel may be instantly set to a predetermined position, control being located in a small knob on one edge of the machine.





The device is shown to the left and above. The marionettes were used in producing a home talkie sound film.

The films that are made for use on this new machine are made under the identical conditions by which theatrical talkies are made. All synchronization troubles are overcome in this device.

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Skyhooks for Airplanes

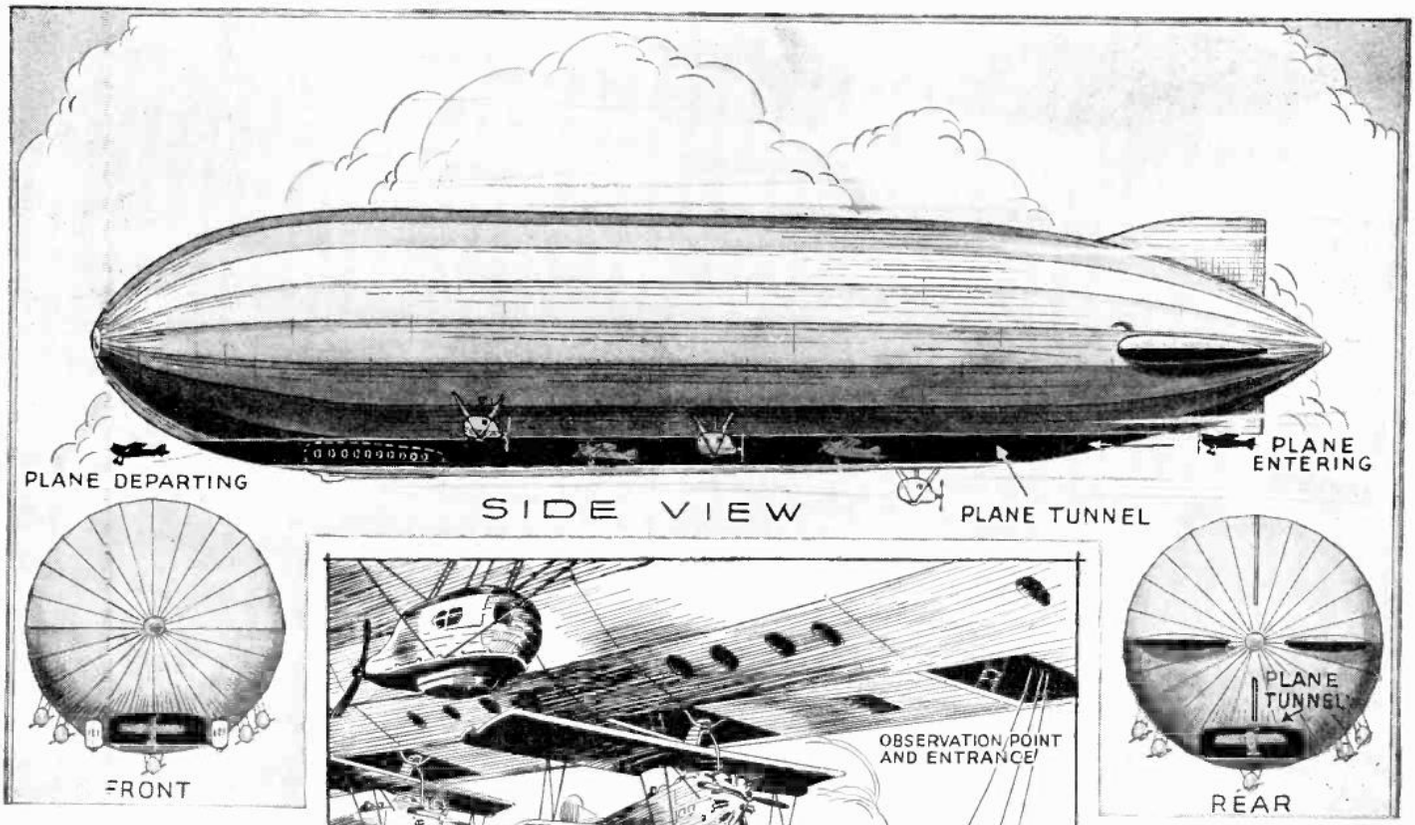
By Botho von Romer

Los Angeles Makes Successful Tests in "Hooking" Planes in Mid-Air

DURING the World War, military officials in Germany made tests with a flying airplane hangar. High speed planes used for delivering important messages were suspended from dirigibles. They were released while the carrier was in midair and in motion. Although these experiments were encouraging, little information regarding them was made public. After the war this problem was taken up in England and first practically carried out with a De Haviland light plane, type 53, and later with a Gloster pursuit plane on the dirigible R-33.

In America we have gone a step further and have been successful in recovering the planes after they have been discharged from the dirigible. The construction of one form of auxiliary apparatus employed in this feat is shown in the drawing appearing on this page. In order for the plane to engage with the dirigible, both must be traveling with the same approximate air speed. The pilot of the plane tries to reach the trapeze grappler, hanging from the dirigible with the grappling apparatus attached to the upper wing of the plane. In a similar way the attached plane is lowered, the motor of the plane is started and, when sufficient speed has been obtained, the plane is released and flies away. The dirigible *Los Angeles* recently carried on several successful tests with a standard size plane of average weight. The plane coupled itself to the dirigible trapeze gear three times, each time disengaging itself, then maneuvering into position and reattaching itself to the mother ship. Naval experts predicted extensive use of this liaison service between dirigible and plane in the future.

Naval and military experts are now considering flying airplane hangars. These are of unusual design and undoubtedly far better than those which make use of a grappling attachment. A tunnel extends along the entire bottom of the dirigible, with an opening at the front and the rear. The tunnel is fitted with a smooth floor, which forms a platform for the landing and take-off of airplanes. The landing plane flies through the rear of the tunnel and emerges from the front when launching. The tunnel provides a place for reserve planes and also holds them while they are being repaired.



Above are a front, rear and side view of the flying airplane hangar. A tunnel is provided along the bottom portion of the dirigible and forms a landing and take-off platform for the airplanes.

The illustration at the right shows how planes are now caught and secured to the dirigible while in midair. In a similar manner, by using the grappling apparatus, planes are launched from the mother ship. The motor on the plane may be started electrically and when sufficient speed has been developed the craft is released.

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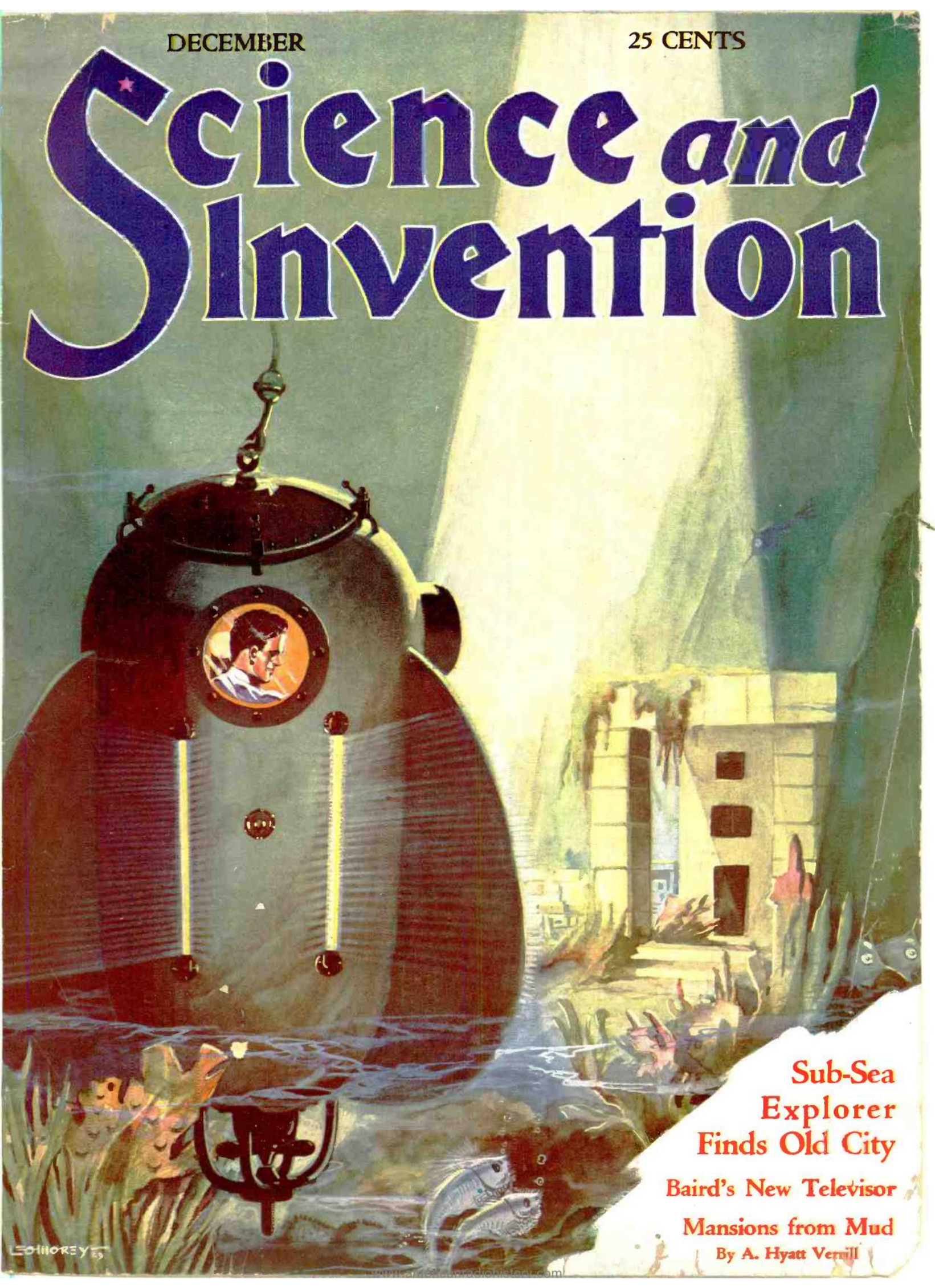
DECEMBER

25 CENTS

Science and Invention



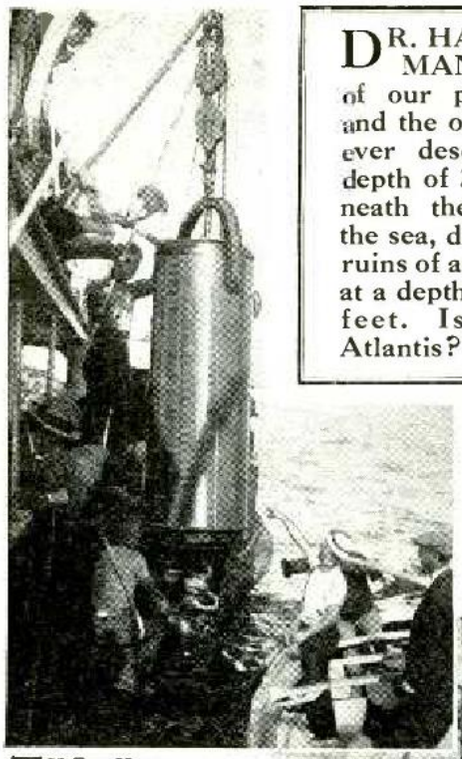
Sub-Sea Explorer Finds Old City

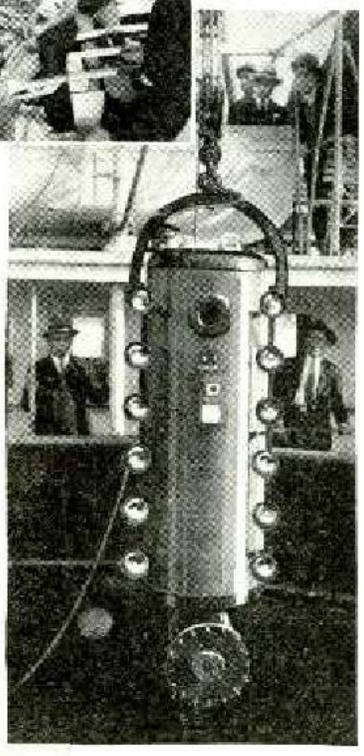
Baird's New Televisor

Mansions from Mud

By A. Hyatt Verrill

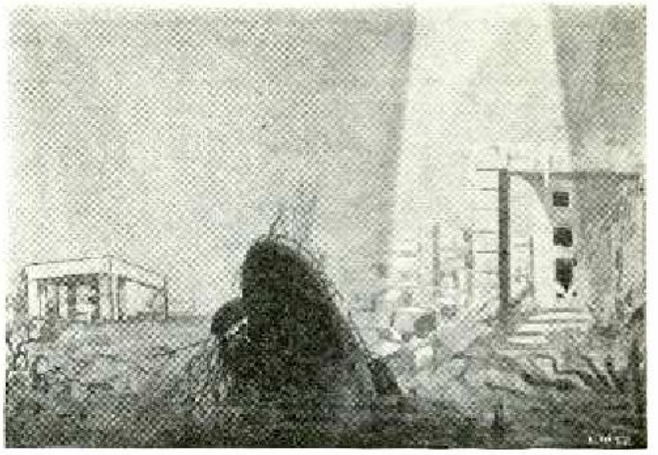
DR. HANS HARTMAN, the hero of our present story and the only man who ever descended to a depth of 2,500 feet beneath the surface of the sea, discovered the ruins of an ancient city at a depth of about 350 feet. Is it the lost Atlantis?





THE Hartman deep-sea exploring bell, in which he was later submerged to great depths never before reached by man, is shown being hoisted overboard in the Mediterranean in the photo above. In the model of diving bell here shown, the "movie" camera was enclosed in a separate steel bell fitted with a quartz glass window, and attached to the bottom of the bell with a magnetic coupling; if the main bell became fouled, the operator could release it, causing the bell to rise.

IN the photo above the special quartz high candle-power electric lamps are shown on either side of the diving bell. Dr. Hartman can be seen standing at the left of the diving bell in the photo above; while the photograph at the immediate left shows the diving bell being lowered into the waters of the Mediterranean. The top steel cover on the bell is bolted on, but in the newer design of bell quick-acting hand-screw clamps will be employed, the old design requiring too much time to open. In all such sub-sea work, it is imperative to be able to release the diver quickly in case he should collapse and have to be hauled to the surface.



2,500 FEET UNDER *the*

American Scientist Breaks All Depth Sunken City in the Mediterranean.

An Interview with

Dr. Hans Hartman

By H. E. Serner

Consulting Engineer

COURAGEOUS men went to frozen poles, into tropical wilds and burning deserts in quest of knowledge. Others traced ancient culture, establishing piece by piece the earliest dawn of human civilization. The earth has now been explored and white spots on the maps have vanished.

And yet—the greatest veil lingers—a veil covering the mysteries of more than two-thirds of the globe. The depths of the oceans are still unknown. True, they have been sounded, and fragile nets brought up a few of the smallest luminous denizens of that mysterious abyss, proving that life extends far down into the greatest depths, into eternal darkness and tremendous pressure.

According to science all life began in the water. From microscopic forms in the flat shelves of the ocean it grew to gigantic types, the Saurians who probably were wiped out by the first ice-age, after some had emerged and lived on land while others went deeper and deeper during untold generations to the ocean floor. Those great depths were not affected by the ice which may have enveloped our earth for ages to be counted perhaps by many thousands of years. Are their monstrous descendants still down there and have any higher forms of life been gradually born in that unknown abyss? We do not know!

What are the obstacles in the way of exploring the ocean depths? Only pressure and darkness! Can they be surmounted by modern engineering science? Three hundred years ago the diving bell with open bottom was invented and much later diving suits; both exposing their users to the pressure of the water. Since then almost no real progress can be recorded. A few pioneers tried at the risk of life and fortune, to descend deeper with devices they invented. But they seldom found moral support, or financial

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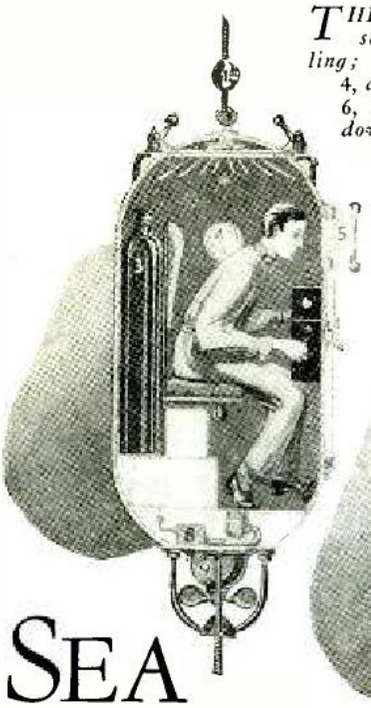
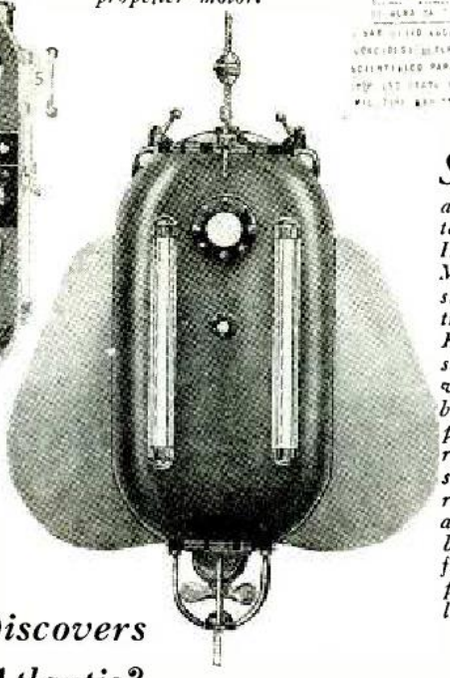


THE latest Hartman deep-sea bell: 1, magnet coupling; 2, clamps; 3, oxygen; 4, depth gauge; 5, window; 6, movie camera and window, 7; 8, air purifier; 9, propeller motor.



SOME idea of the remarkable depth obtained by Dr. Hartman in his Mediterranean sub-sea explorations with his Krupp built steel diving bell will be gained by looking at the picture at the right. Here we see that a diver reaches his limit at about 300 feet below the surface where the pressure is 133 lbs. per sq. inch.

INTERESTING telegram received by Dr. Hartman from Mussolini appears at the left and reads as follows:

Dr. Hartman, Hotel Excelsior, Naples, SS Roma: Referring to your letter of the 21 of the present month, we give you authorization for submarine photographic operations for scientific purposes at Capri and the Pozzuoli Gulf, and Baia and Cape Miseno. This is by arrangement from the military authorities in Naples. Marine Minister, Mussolini.

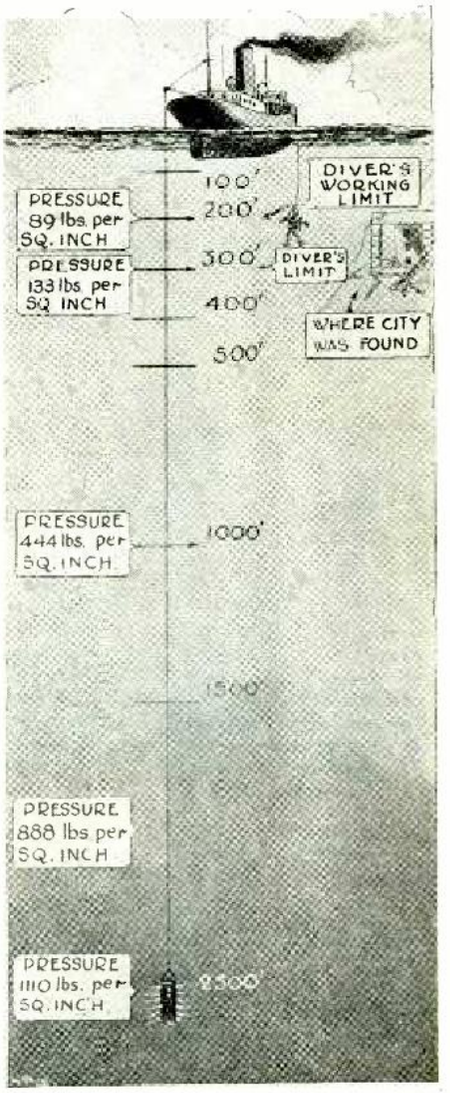
SEA

Records and Discovers Is It the Lost Atlantis?

assistance. Some were ridiculed, others lost their lives. Some inventors constructed armored diving suits, which were very dangerous due to many joints which afforded possible leakage of water. Others built hermetically closed diving chambers.

One of the later pioneers in this magnificent and virgin field is Dr. Hans Hartman, an electrical engineer of New York City, who has worked and dreamed all his life to penetrate the depths and illuminate and photograph the secrets of the sea. Already in the December number of 1916, this magazine described and illustrated his automatic deep sea camera, for which the U. S. Navy Department placed the *U. S. S. Vestal* at his disposal, to enable him to make tests and experiments. Dr. Hartman soon found that he needed a diving chamber, wherein he could accompany his camera down on its perilous way.

After several years of work following the close of the World War, Dr. Hartman had developed a deep sea diving cylinder, organized a small expedition to the Mediterranean sea, where he conducted, handicapped by limited finances, interesting research work in and around the Gulf of Naples, photographing submerged ancient ruins of Roman palaces, of the sunken city of Paleopolis and also the subaqueous arch which illuminates the famous Grotto of Capri. Premier Mussolini himself overruled obstacles made by local authorities in Naples, by telegraphing from Rome to Dr. Hartman his special permission. Europe became interested in the American submarine explorer's work (*Continued on page 738*)



The Man Who Found the Sunken Prehistoric City Off the Coast of Africa

IN conjunction with his consulting engineer, Mr. H. E. Serner, the author of the accompanying article, Dr. Hartman designed the steel cylinder shown in the accompanying pictures. The editors have inspected the final construction blue-prints made by the famous Krupp steel experts in Germany, who built the seamless steel bell used in these remarkable explorations at great depths. The Krupp built steel bell was designed to stand a pressure of 2,500 pounds or a sub-sea depth of about 5,000 feet. Dr. Hartman descended to a depth of 2,500 feet. Dr. Hartman and his colleague, Mr. Serner, deserve the highest credit for their energy and courage.

Dr. Hans Hartman has just returned from Europe and this exclusive story tells of the wonderful discoveries he has made in the Mediterranean, off the coast of Sicily.

The map reproduced above shows the point between Sicily and the coast of Africa, where the prehistoric city was discovered.

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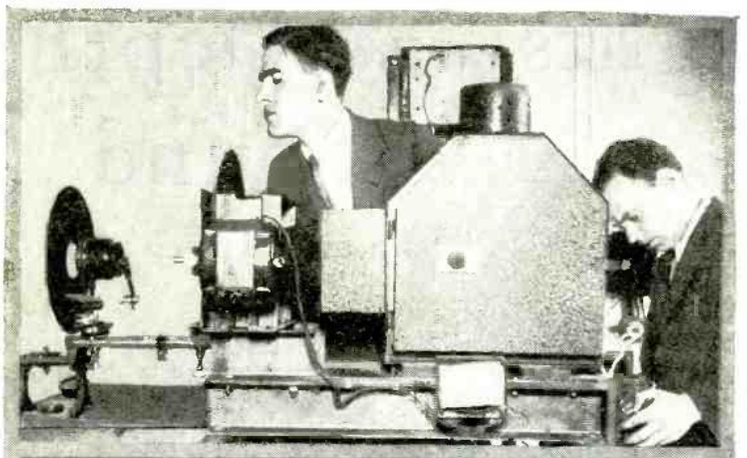
Baird's *Newest* Televisor

Designed to bring "Talking Movies" into your home

By H. Winfield Secor

VOICE and facial image were simultaneously flashed over the wires by means of the newest Baird experimental television system recently, in a demonstration to an audience of newspapermen given in New York City. The presentation was carried out under the direction (*Continued on page 732*)



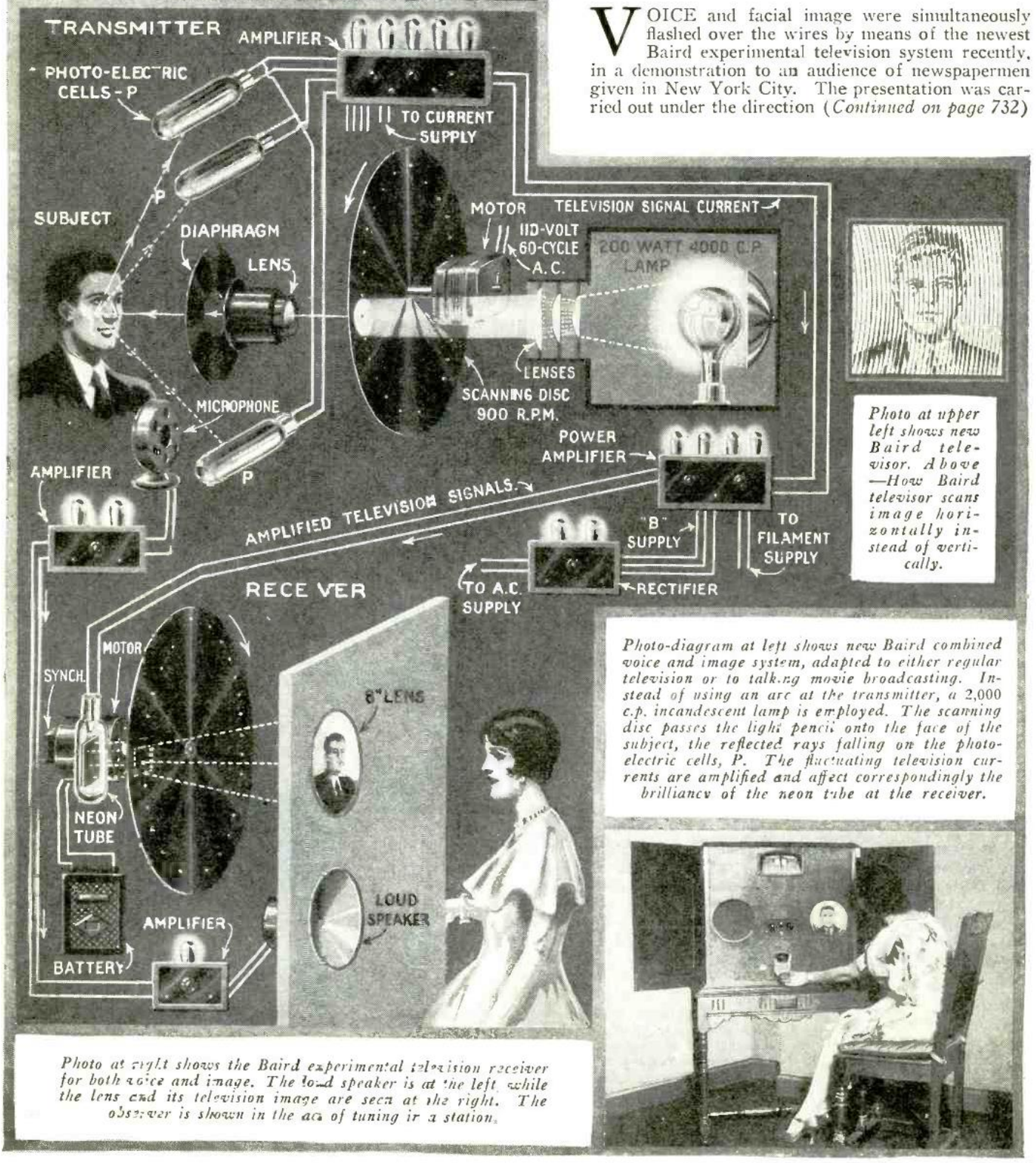


Photo at upper left shows new Baird televisor. Above —How Baird televisor scans image horizontally instead of vertically.

Photo-diagram at left shows new Baird combined voice and image system, adapted to either regular television or to talking movie broadcasting. Instead of using an arc at the transmitter, a 2,000 c.p. incandescent lamp is employed. The scanning disc passes the light pencil onto the face of the subject, the reflected rays falling on the photo-electric cells, P. The fluctuating television currents are amplified and affect correspondingly the brilliancy of the neon tube at the receiver.

Photo at right shows the Baird experimental television receiver for both voice and image. The loud speaker is at the left while the lens and its television image are seen at the right. The observer is shown in the act of tuning in a station.

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JANUARY

25 CENTS

Science and Invention

The City of Tomorrow

In This Issue:

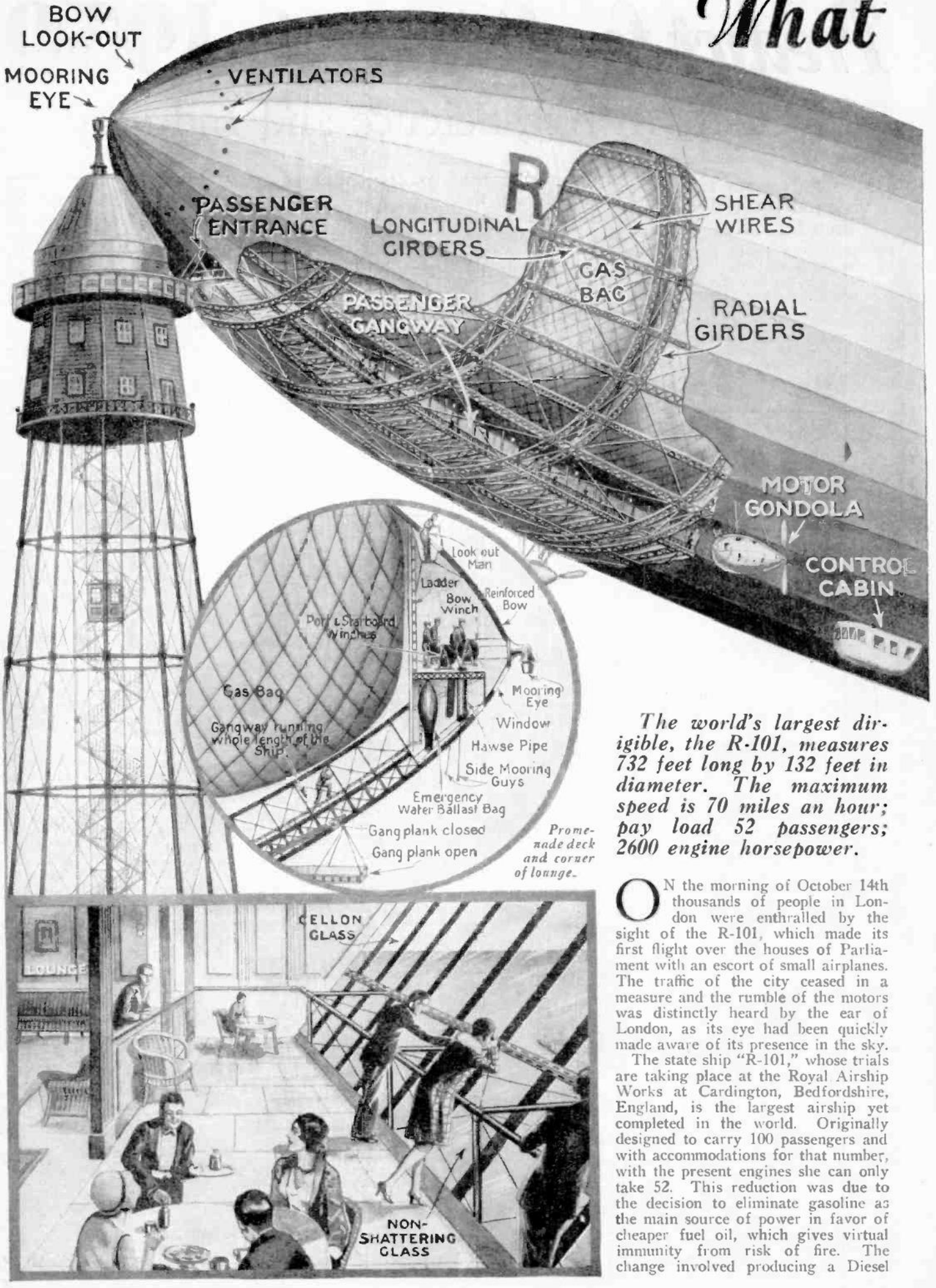
"Casey" Jones

David Belasco

William Dubilier

Walter P. Chrysler

What



The world's largest dirigible, the R-101, measures 732 feet long by 132 feet in diameter. The maximum speed is 70 miles an hour; pay load 52 passengers; 2600 engine horsepower.

ON the morning of October 14th thousands of people in London were enthralled by the sight of the R-101, which made its first flight over the houses of Parliament with an escort of small airplanes. The traffic of the city ceased in a measure and the rumble of the motors was distinctly heard by the ear of London, as its eye had been quickly made aware of its presence in the sky.

The state ship "R-101," whose trials are taking place at the Royal Airship Works at Cardington, Bedfordshire, England, is the largest airship yet completed in the world. Originally designed to carry 100 passengers and with accommodations for that number, with the present engines she can only take 52. This reduction was due to the decision to eliminate gasoline as the main source of power in favor of cheaper fuel oil, which gives virtual immunity from risk of fire. The change involved producing a Diesel

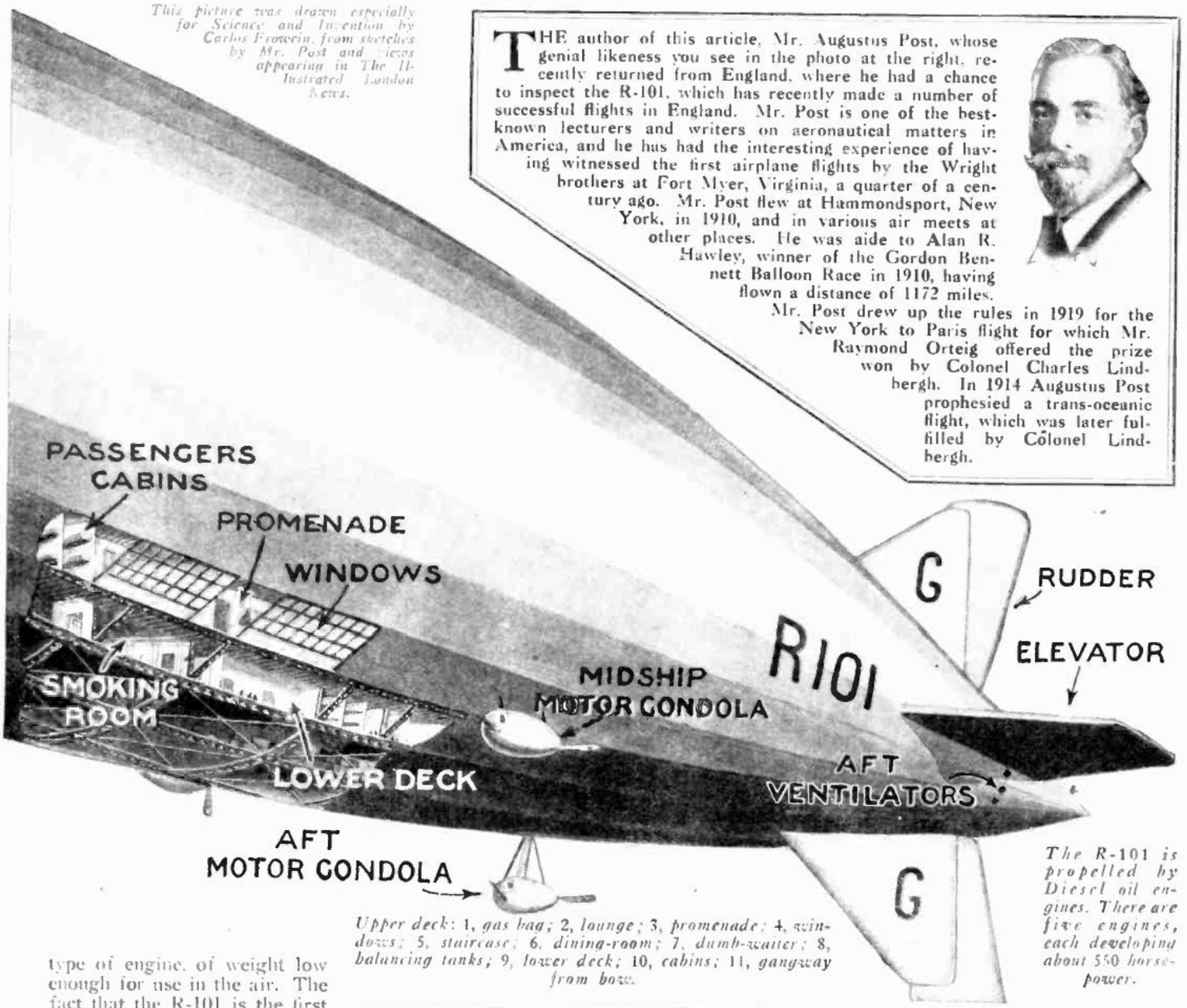
I Found on Board the R101

By Augustus Post

THE author of this article, Mr. Augustus Post, whose genial likeness you see in the photo at the right, recently returned from England, where he had a chance to inspect the R-101, which has recently made a number of successful flights in England. Mr. Post is one of the best-known lecturers and writers on aeronautical matters in America, and he has had the interesting experience of having witnessed the first airplane flights by the Wright brothers at Fort Myer, Virginia, a quarter of a century ago. Mr. Post flew at Hammondsport, New York, in 1910, and in various air meets at other places. He was aide to Alan R. Hawley, winner of the Gordon Bennett Balloon Race in 1910, having flown a distance of 1172 miles.

Mr. Post drew up the rules in 1919 for the New York to Paris flight for which Mr. Raymond Orteig offered the prize won by Colonel Charles Lindbergh. In 1914 Augustus Post prophesied a trans-oceanic flight, which was later fulfilled by Colonel Lindbergh.

This picture was drawn especially for Science and Invention by Carlos Frowein, from sketches by Mr. Post and views appearing in The Illustrated London News.



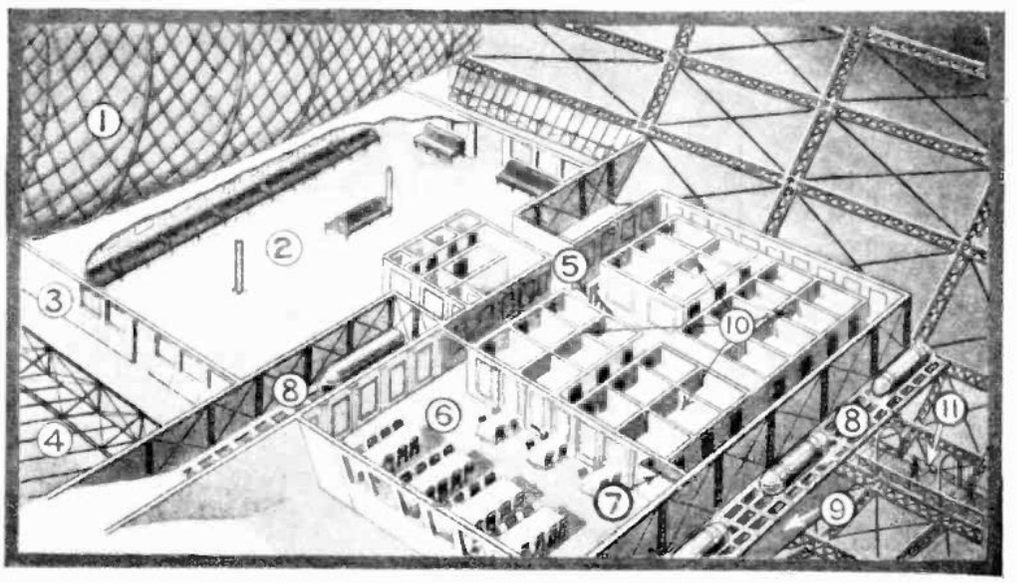
Upper deck: 1, gas bag; 2, lounge; 3, promenade; 4, windows; 5, staircase; 6, dining-room; 7, dumb-waiter; 8, balancing tanks; 9, lower deck; 10, cabins; 11, gangway from bow.

The R-101 is propelled by Diesel oil engines. There are five engines, each developing about 550 horse-power.

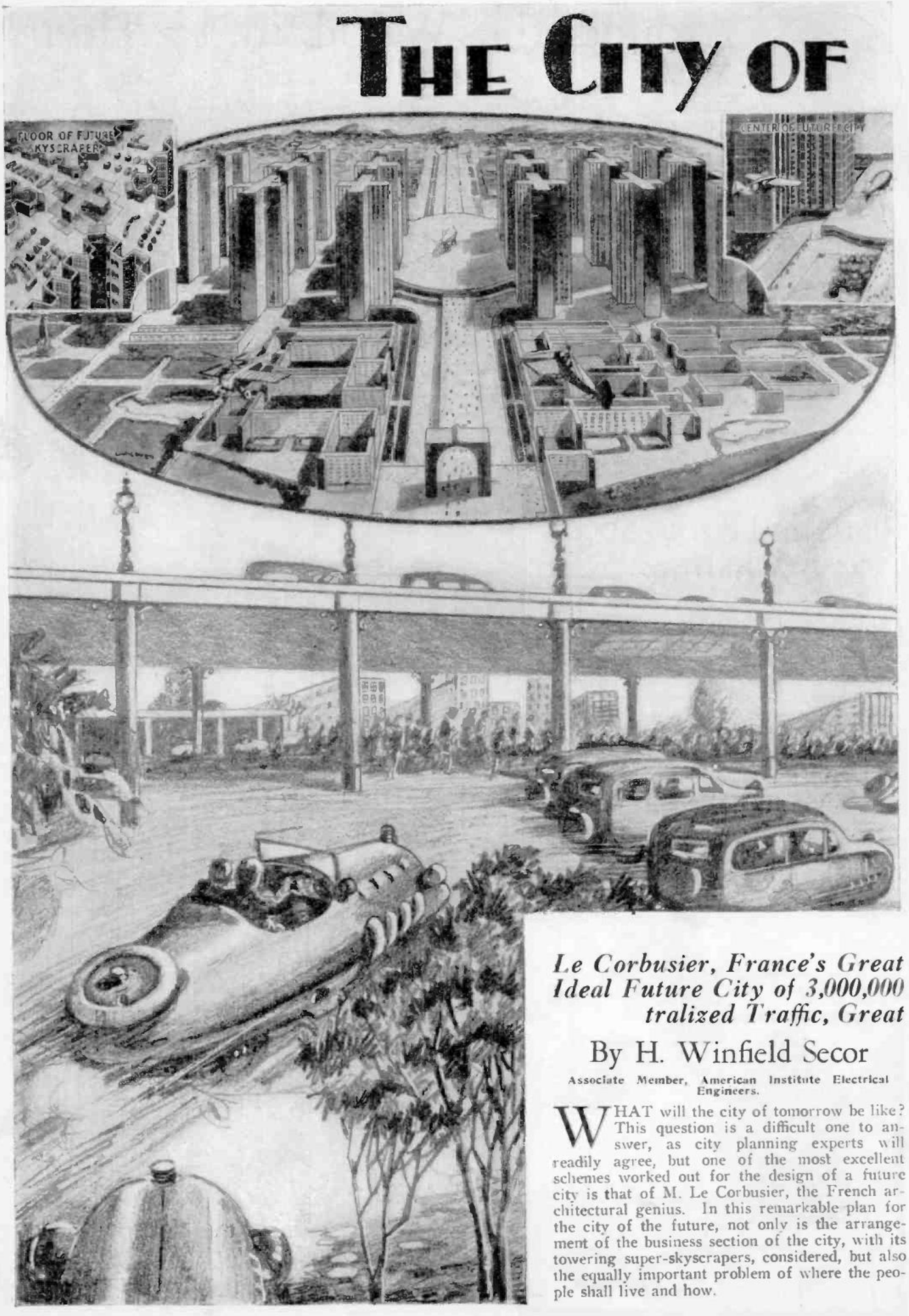
type of engine, of weight low enough for use in the air. The fact that the R-101 is the first airship to dispense with gasoline is an important step in progress.

The framework of the airship is of much larger cross-section than the corresponding part of the *Graf Zeppelin*, as it is designed to withstand strong rising air currents such as may be found in tropical countries, where they even range as high as 45 miles per hour. The passenger rooms are spacious and comfortable and are made chiefly of light wood, duraluminum and aluminum. The chairs and furniture are extremely light, although they present the apparent solidity of the furnishings of an ocean liner.

(*Continued on page* 840)



THE CITY OF



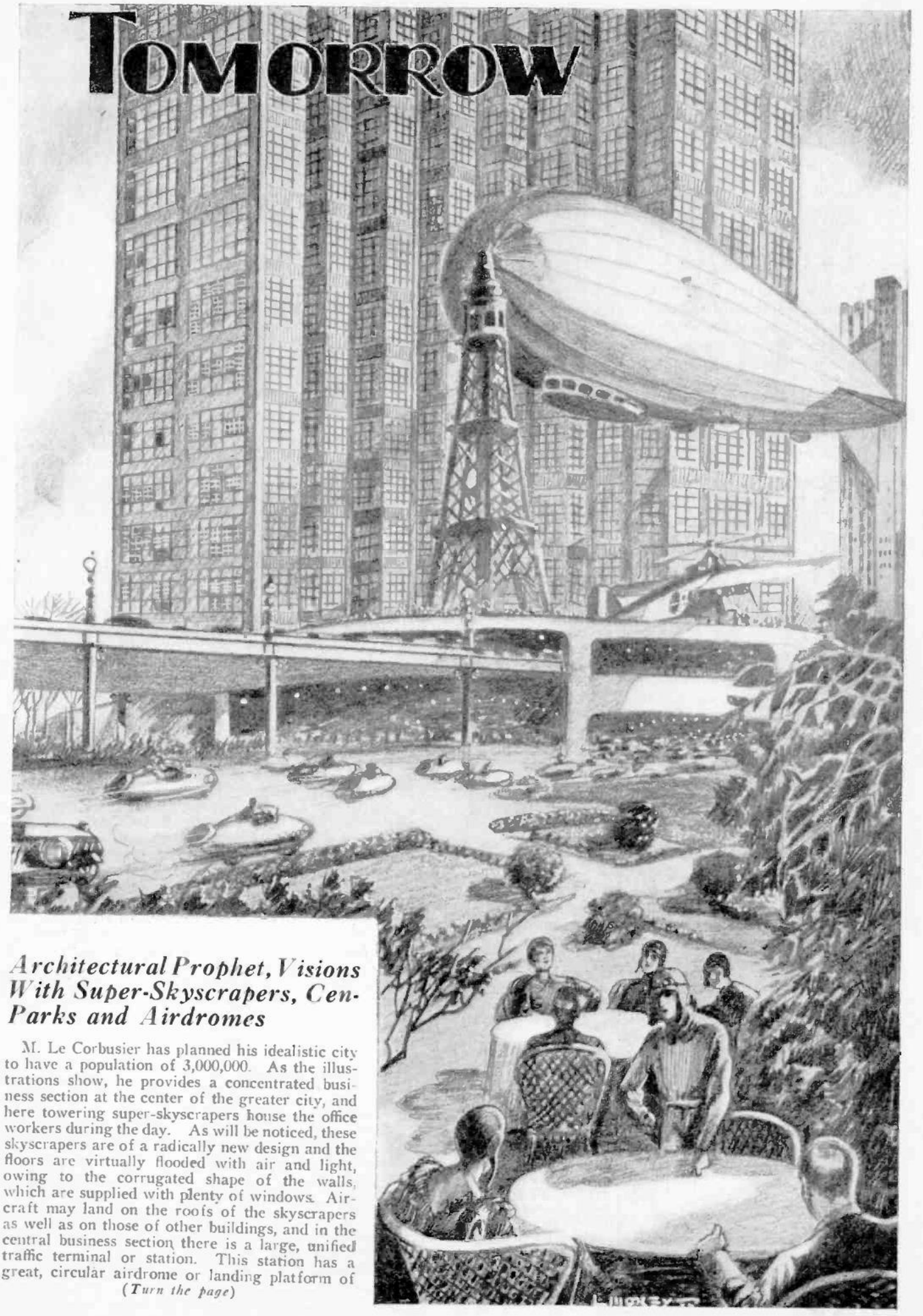
Le Corbusier, France's Great Ideal Future City of 3,000,000 tralized Traffic, Great

By H. Winfield Secor

Associate Member, American Institute Electrical Engineers.

WHAT will the city of tomorrow be like? This question is a difficult one to answer, as city planning experts will readily agree, but one of the most excellent schemes worked out for the design of a future city is that of M. Le Corbusier, the French architectural genius. In this remarkable plan for the city of the future, not only is the arrangement of the business section of the city, with its towering super-skyscrapers, considered, but also the equally important problem of where the people shall live and how.

TOMORROW



Architectural Prophet, Visions With Super-Skyscrapers, Cen- Parks and Airdromes

M. Le Corbusier has planned his idealistic city to have a population of 3,000,000. As the illustrations show, he provides a concentrated business section at the center of the greater city, and here towering super-skyscrapers house the office workers during the day. As will be noticed, these skyscrapers are of a radically new design and the floors are virtually flooded with air and light, owing to the corrugated shape of the walls, which are supplied with plenty of windows. Aircraft may land on the roofs of the skyscrapers as well as on those of other buildings, and in the central business section there is a large, unified traffic terminal or station. This station has a great, circular airdrome or landing platform of

(*Turn the page*)

Future City *Plans Promise* Traffic Relief—*Better Light*

large area for planes and dirigibles. Below this platform there are other levels, reached by communicating stairways and elevators, where high-speed automobile traffic from north to south and east to west passes through the street level intersection. Below this one finds himself on the station platforms of the high-speed railroad system. Suburban sections are well served with trains operating on loops.

M. LE CORBUSIER'S dream of the future city is one of the most comprehensive plans ever proposed, taking into consideration as it does the handling of traffic, improved dwellings for the workers, as well as super-office buildings and airdromes right in the city.

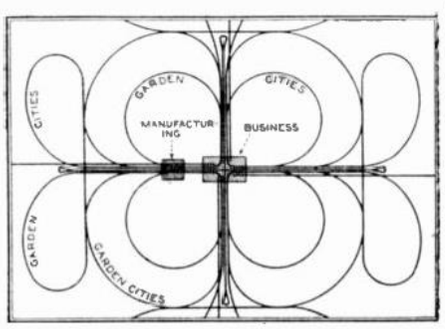
NEW YORK CITY WITH ITS HIGHLY CONGESTED SKYSCRAPER DISTRICT

The photo above shows lower New York City with its great mass of skyscrapers. Note that about 60 per cent of the ground area is covered with buildings and only a few per cent devoted to grass and trees, so greatly needed to purify the air.

One of the main arguments for this design of city is that while we may have a highly concentrated population in the business section or center of the great city of tomorrow, traffic, especially with regard to automobiles and trains, should be simplified. In this most comprehensive and promising plan of Le Corbusier's, the matter of caring for the traffic would seem to be well worked out. It is only a matter of having the principal arteries of traffic made large enough to take care of a great many automobiles or trains. In other words, this genius' idea is to have a few large arteries of traffic separated a much greater distance than is the present plan in practically all of our cities today.

Among the many practical details which are presented in Le Corbusier's plan for the city of tomorrow he has given careful study to the health and welfare of the population. Instead of covering, say 50 to 60 per cent or more of the area of the city's ground with buildings, with a few trees in small parks spaced half a mile or more apart, he has designed skyscrapers and residential buildings of a type which only occupy about 5 per cent of the ground area, leaving 95 per cent of the ground for trees, grass, lakes, etc. People need pure air, even in the city, if they are to be thoroughly healthy and accomplish their work properly. One of the accompanying pictures shows in how great proportion the park (or tree and grass) area in a city like New York would be increased if M. Le Corbusier's plan were applied instead of the present one, where one can see nothing but buildings studding practically the whole ground area, when viewed from an airplane.

The general plan of the great future city and its environs calls for a centralized business section, where the skyscrapers are surrounded by a considerable number of residential blocks, liberally interspersed with parks. The main boulevards carrying motor traffic would then lead across intervening country (protected zones) to so-called "garden cities," where plenty of green trees and grass would provide a very healthy and delightful living section. Large lakes and woodland would be found in the intervening protected zones, between the central part of the city and the garden cities.



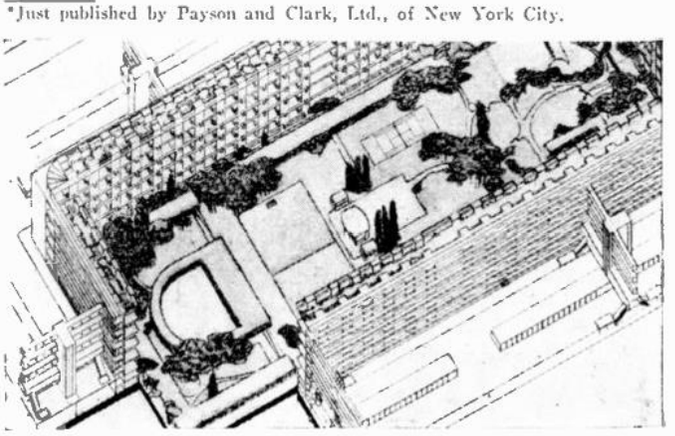
Plan of the City of Tomorrow centralized railroad system as visualized by Le Corbusier. The business and manufacturing centers are localized; the people may live in cellular type dwellings adjacent to the business section or in the suburban garden cities served by the railroad loops. Picture at right—one of the plans for housing the people in dwellings built on the "cellular" system. Note the large park area.

With regard to the super-skyscrapers of the type here proposed, examination of the typical floor plan as shown in one of the accompanying pictures, reveals the fact that the buildings are designed in the form of a cross, thus doing away with an internal court and giving maximum stability to the structure. The façades are deeply serrated and form veritable traps for light. The capacity of one of these super-skyscrapers 460 feet long and 700 feet high is 30,000 employes, allowing 10 square yards per person; while one of these skyscrapers 540 feet long would have a capacity of 40,000 people. Long roads of compact garages, multiple floors of which may be placed underground with elevators or ramps, are to be found on the ground level, and these garages are placed in the angles between the wings of the skyscrapers. All motor-car traffic is gyratory. A peculiar sight strikes one's eyes on the ground level as the skyscrapers are not walled in, but one sees the numerous steel columns which carry the sixty stories. This leaves open space for freight storage, etc. The elevator and stairway shafts are enclosed, but the frames are open. It is a fact not often realized perhaps that if one took away the outer foundation wall from under one of our present-day skyscrapers, the skyscraper would still be safely supported by the steel and concrete piles underneath it, which go down to a solid footing.

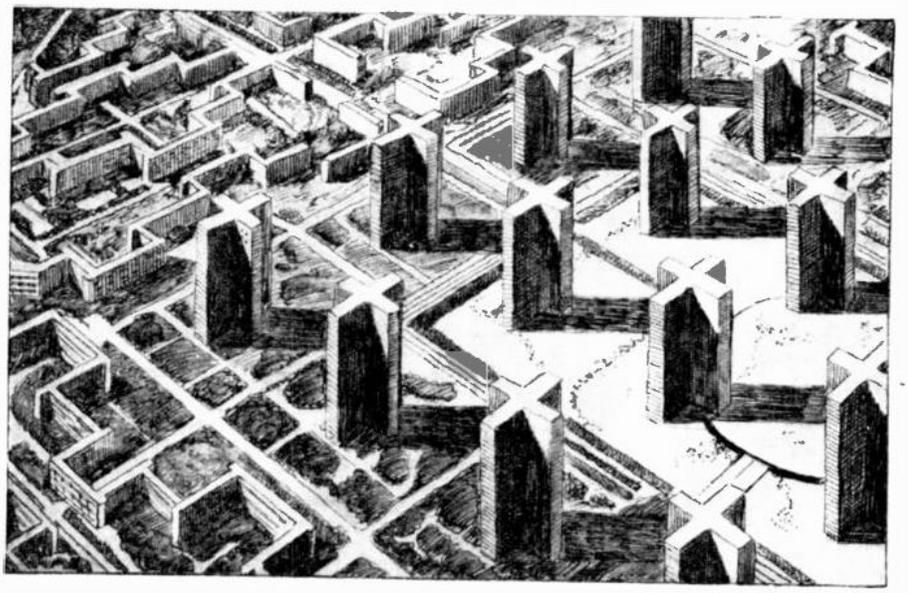
M. Le Corbusier, in one of the chapters on "a typical working day" in the future city, as given in his remarkable new work, *The City of Tomorrow*,* says: "It is 9 A. M. . . .

"From its four vomitories, each 250 yards wide, the station disgorges the travelers from the suburbs. The

*Just published by Payson and Clark, Ltd., of New York City.



More Parks—*Centralized Rail Terminal*—Roof Airports



AS NEW YORK WOULD LOOK WITH LE CORBUSIER'S PLAN IN EFFECT

Lower New York as Le Corbusier would lay it out, with buildings occupying about 5 per cent of the ground area, the rest being devoted to air-purifying parks.

THE plan here presented for the City of Tomorrow calls for a population of 3,000,000, but it can be enlarged to any desired scale. The skyscrapers of improved type giving more light and air are about 450 feet across and 700 feet high. All traffic lines are centralized.

trains, running in one direction only, follow one another at one-minute intervals. (In Berlin at the 'Zoo' station, where many lines meet, this masterpiece of precision has been in operation for years.) The station square is so enormous that everybody can make straight to his work without crowding or difficulty.

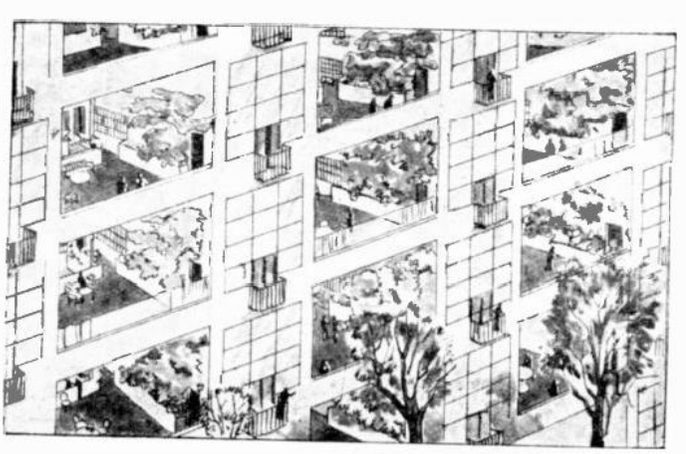
"Underground the tube taps the suburban lines at various points and discharges its passengers into the basements of the skyscrapers, which gradually fill up. Every skyscraper is a tube station.

"A skyscraper is, in fact, a whole district, but verticalized! Ten thousand to fifty thousand employes pass their day in it, each with a minimum superficial area of ten square yards to work in. The original and primitive conception of the skyscraper comes to us from America; but if the disposition of these shown in my scheme is compared with an aerial photograph of New York, where the skyscraper completely holds up Manhattan, it will be seen how great is the contrast between the latter and a rational and clear conception where a large outlook has been the deciding factor in the relation to each other of these indispensable elements. In New York City 20,000 people invade a narrow street at practically one moment, and the result is complete chaos; all fast traffic is paralyzed and the idea for which the skyscraper stands is robbed of all significance. Created for the purpose of decongestion, actually it slows up all traffic and is, in fact, a powerful factor for congestion. The result is that people cry out against the skyscraper and the vertically built city, and because of the need to get about quickly, oppose the type of city which is spread out over a very large area. So we have a new paradox. Since New York City (Manhattan) is to some extent an absurdity, the whole idea is vehemently attacked. The truth is that the skyscraper, as we have it in New York, will not do, for by means of it New York has increased its density to too great an extent, without proper provision for the necessary approaches. New York City is wrong, but the skyscraper remains a noble instrument. But if you are going to increase the density of your population, you must at the same time make full provision for getting it away. There are two sides of a medal; one cannot exist without the other. . . . In a few moments the city fills up. Work begins and, speeded up by efficient organization, goes on busily in luminous and even radiant offices whose immense windows open full on the sky and the lofty horizon, where the air is pure and noise far distant.

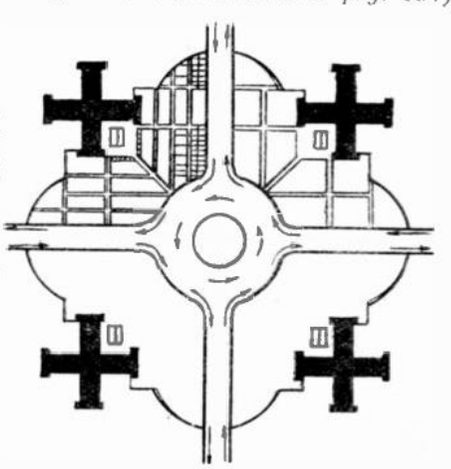
"Then, perhaps, the working day may finish after midday. The city will empty as though by a deep breath. The *garden cities* will play their full part. And, on the other hand, in the city itself the residential quarters will offer new living conditions to these new men of a mechanical age."

Thus does the prophetic French architect paint the picture of a business day in the city of tomorrow. Doubtless we shall also have new forms of heat and light when the coming generation takes office. Radio telephones will be found in all offices and automobiles will be driven by some new form of fuel, possibly by electric waves.

As some of the accompanying illustrations indicate, the residential angle of the future city has been carefully studied and one of the main underlying ideas is to provide residential apartments arranged in long winding strips, one type of which M. Le Corbusier calls *blocks of dwellings with setbacks*. Another suggested style of residence he calls *dwellings built on the cellular system;* the height of the building for example in the cellular plan is 110 feet above the ground. The "building" is made so narrow that plenty of fresh air and sunlight flood the rooms at practically all times. Furthermore, practically 95 per cent of the ground area can be devoted to lakes, green grass and (*Continued on page* 834)



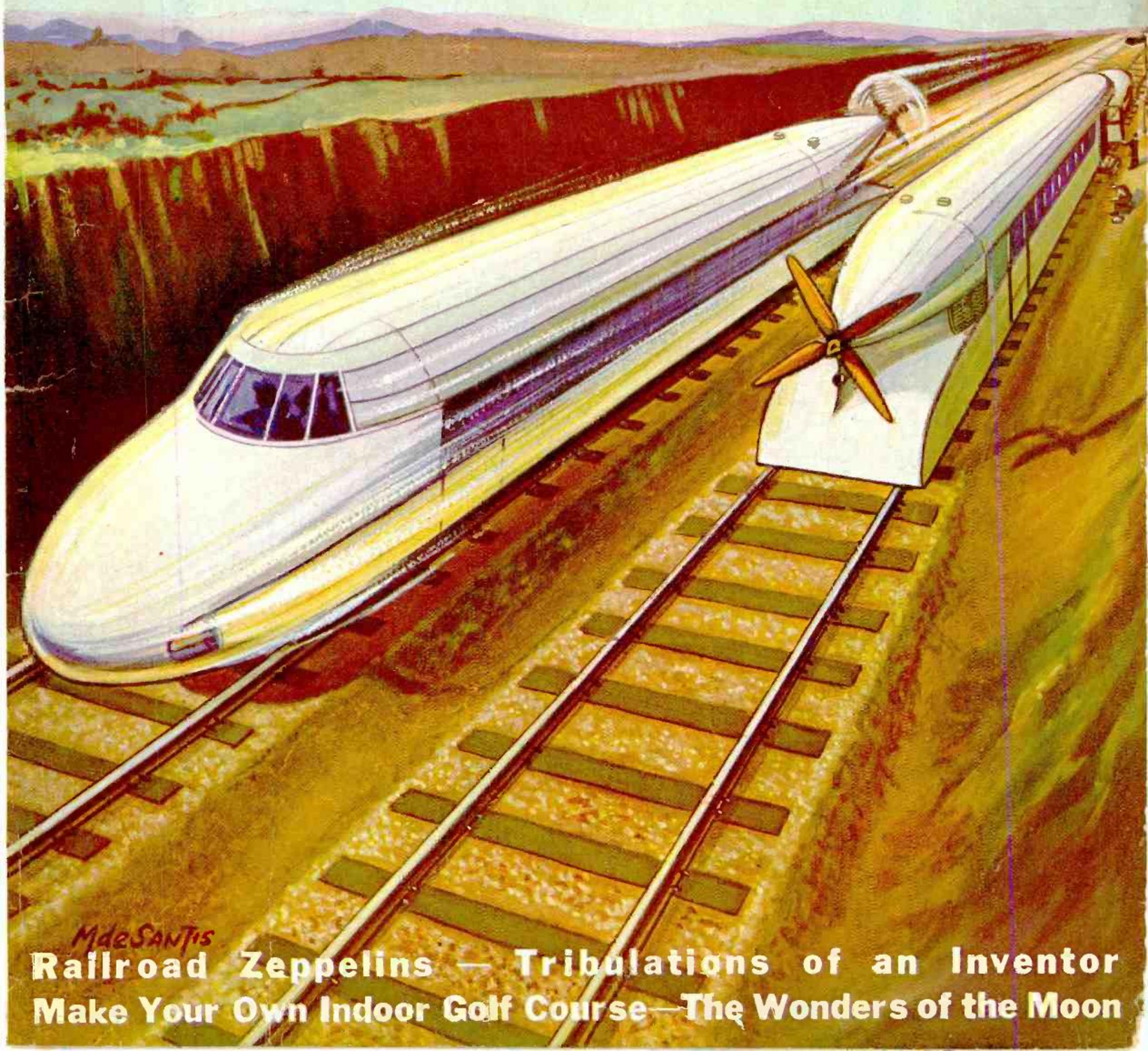
The picture at the left shows a close-up of blocks of dwellings built on the "cellular" system proposed by Le Corbusier. The buildings are ten stories high. Plan at right shows street crossings for fast auto traffic in future city. All traffic is gyratory.



Science and Invention

FEBRUARY

25 CENTS



Railroad Zeppelins — Tribulations of an Inventor

Make Your Own Indoor Golf Course—The Wonders of the Moon

Escaping Neptune's

From Time to Time the World Is Shocked by the News of Some Terrible Submarine Disaster in Which Many Lives Are Lost, Often After Hours or Days of Slow Suffocation. Readers Will No Doubt Recall the Special Broadcast Describing the Training Which Crews of U. S. Submarines Now Undergo to Enable Them to Escape From Sunken Submarines by Means of the Newly Invented Momsen Air Lung. This Article Describes the Training Process

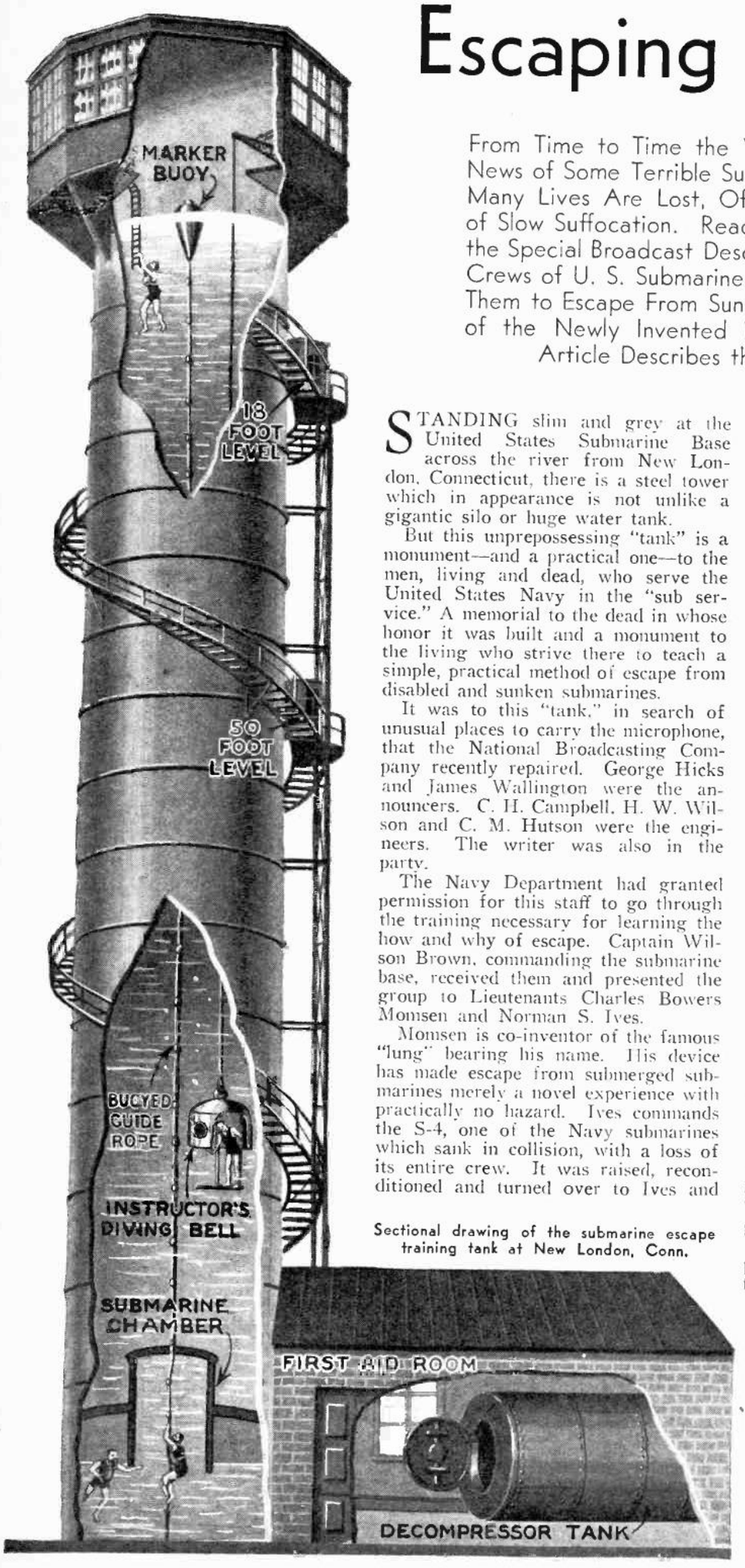
STANDING slim and grey at the United States Submarine Base across the river from New London, Connecticut, there is a steel tower which in appearance is not unlike a gigantic silo or huge water tank.

But this unprepossessing "tank" is a monument—and a practical one—to the men, living and dead, who serve the United States Navy in the "sub service." A memorial to the dead in whose honor it was built and a monument to the living who strive there to teach a simple, practical method of escape from disabled and sunken submarines.

It was to this "tank," in search of unusual places to carry the microphone, that the National Broadcasting Company recently repaired. George Hicks and James Wallington were the announcers. C. H. Campbell, H. W. Wilson and C. M. Hutson were the engineers. The writer was also in the party.

The Navy Department had granted permission for this staff to go through the training necessary for learning the how and why of escape. Captain Wilson Brown, commanding the submarine base, received them and presented the group to Lieutenants Charles Bowers Momsen and Norman S. Ives.

Momsen is co-inventor of the famous "lung" bearing his name. His device has made escape from submerged submarines merely a novel experience with practically no hazard. Ives commands the S-4, one of the Navy submarines which sank in collision, with a loss of its entire crew. It was raised, reconditioned and turned over to Ives and Momsen to use in the study and development of safety devices. Momsen is in charge of instruction at the "tank." Ives assists him.



Sectional drawing of the submarine escape training tank at New London, Conn.

The author, Wm. Burke Miller

At the base of the submarine escape-training tank there is a small brick house. Inside this is the technical set-up for operating the "tank." Along one side there is a small drum-like tank. Momsen led the N. B. C. group to this point upon their arrival at the Base.

The engineers, headed by Campbell, began studying the "tank" proper for setting up radio equipment. Momsen, meanwhile, invited Wallington, Hicks and myself to enter the drum.

"What's the idea?" asked Wallington.

"Must check your reaction to high pressure," Momsen replied as he slipped his sweater and shirt over his head. "Better take off your coats and vests," he added, "but take 'em in with you. Leave your fountain pens and watches outside."

"Why's that, Lieutenant?" queried Hicks, a bit anxiously.

"Pens might burst and spatter us with ink and the pressure would probably ruin your watches," Momsen said. The three embryo "lungers" exchanged glances.

The inside of the small drum is painted white. A smooth, hardwood floor covers the bottom. There are no seats. A few handles and gauges are on the wall.

Momsen followed the trio in and slammed shut a round door which somewhat resembles that of a bank vault.

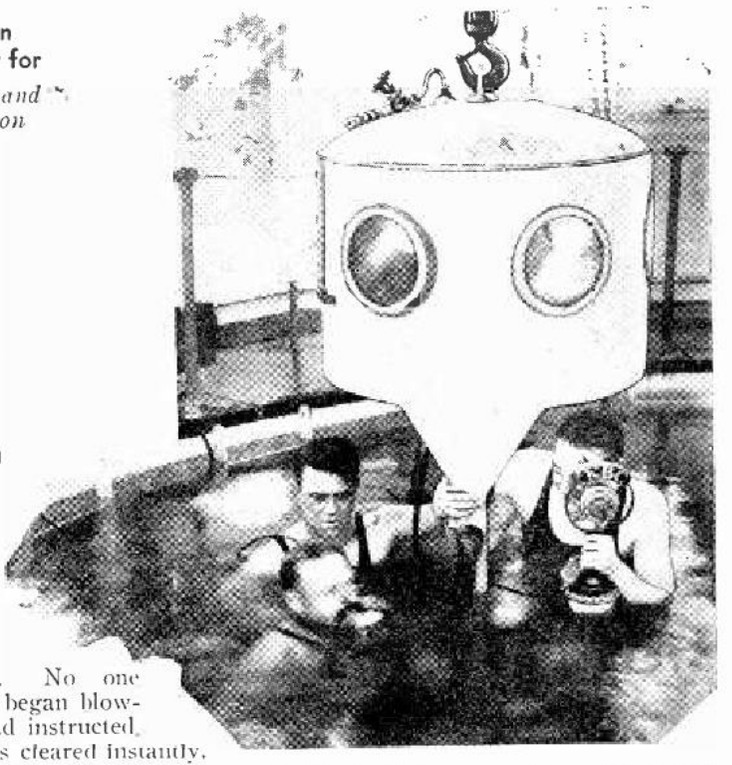
"Our personnel now is required to take pressure only up to fifty pounds per square inch. After that it's optional," Momsen explained. "None of the men has to take the training beyond that and at present do not have to accept instruction at a depth greater than eighteen feet. But none

Clutches

Written Specially for *Science and Invention*

By Wm. Burke Miller
Director of Special Broadcast Events, National Broadcasting Company

In the Following Article, Mr. Miller Gives a Thrilling Account of the Experiences Which He and His Fellow Announcers Encountered While Undergoing Training Prior to Giving a Broadcast from the U. S. Navy Training Station at New London, Conn.



Lt. Charles B. Momsen and James Wallington receiving Edward Kalinoski (Chief Torpedoman on the ill-fated S-4) as he broke surface with the Momsen "lung." Wallington is giving the unseen audience details of the feat.

of them is content with that, and after one experience they ask for the entire course.

"To escape from a hundred-foot depth we must undergo a pressure of nearly fifty pounds. That's what I've got to test you for now. Here goes."

A hissing sound crashed through the boiler. No one could say a word. The boys sat on the floor and grinned a bit foolishly at one another. There was no sensation. The hiss ceased as quickly as it had begun.

"It's up to five pounds now," Momsen said. "I'll take it slow at first. You may experience a little difficulty with your ears," he added. "If so, hold your nose, close your mouth and blow. The ears should pop open. If they don't, hold up your hand and I'll cut the pressure."

George Hicks, N. B. C. Announcer.

Before anyone could ask a question, the air hiss began again, and seemingly at a faster pace. The air became a trifle warm. Perhaps a minute passed—it seemed longer. Again the hissing stopped as abruptly as it began.

"All right?" Momsen queried casually, though studying each man closely. His voice sounded high and queer. Wallington started to speak. His voice was high-pitched, too. Hicks and I laughed. Then all began howling. All voices seemed affected and it started all to laughing upon the discovery.

Momsen smiled. "Air pressure seems to affect the larynx," he explained. "Try to whistle."

It was hopeless.

"Why is that, Lieutenant?" Hicks asked, and his usually deep, resonant voice was like a small boy's. The laughing fit began all 'round again.

"This is serious, Lieutenant," someone said. "These boys will not be understood over the air. No one will be able to understand a word they say."

Momsen's reply was a hiss of air that continued for seemingly a long time. It grew warmer and perspiration popped out on all. Ears began to ache slightly. No one raised a hand but began blowing as Momsen had instructed. Sometimes the ears cleared instantly, once or twice it took longer. The air now was hot.

The air hiss ceased.

"Hurt much?" asked Momsen, but no one would have recognized his voice. "Probably did between fifteen and twenty pounds," he said, answering his own question. "It's around thirty-eight pounds now. You should have no more clogging of the ears."

Wallington was massaging his left ear vigorously. It had not entirely cleared. Hicks seemed unaffected. He explained he had only one ear drum, the other having been operated on. Momsen nodded and turned on the air again. A few seconds and the needle on a gauge pointed just slightly over the fifty-pound mark.

A few minutes' experimenting with their voices, and then Momsen began to decompress the tank. The air grew chilly and a white vapor enveloped all. This process was continued and the coats and vests were hurriedly put on and were most welcome. Soon a pounding was heard outside. Momsen responded from within, a short delay and the door was open.

James Wallington, N. B. C. Announcer.

"All O. K.," said Momsen to a petty officer who asked each man's name and wrote it into a ledger.

"But what has this to do with escaping from a submarine?" Wallington began.

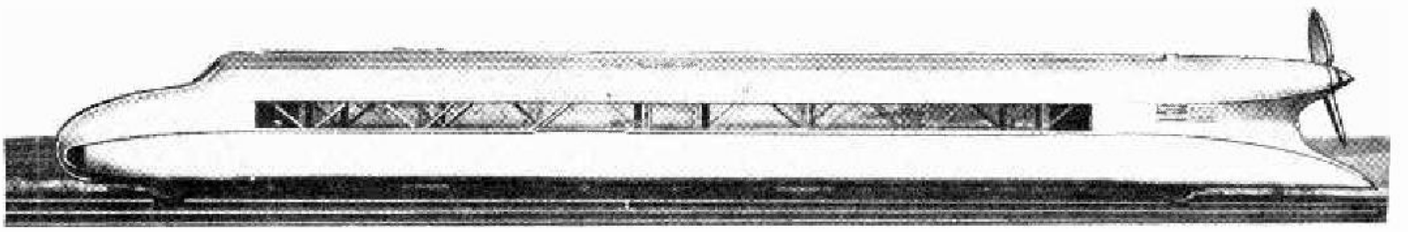
"You'll understand once we go through the training tank," Momsen replied.

A tour of the training tank followed. At the bottom, within the "tank" proper, there is an exact replica of a submarine compartment. It is built to specification and everything resembles one section of a submarine. In the center there is a hatch and below it, extending down into the compartment some five or six feet, there is a skirt-like bell.

"Above you now," said Momsen, after the group had entered, "there are a quarter million gallons of warm salt water. That's the only thing here not according to Hoyle," he smiled. "We plan to use this tank all winter and in training men it would not be fair to send them through cold water time and again."

(*Continued on page 952*)

Photograph of the New London training tank, which is 130 feet high, including the observation gallery at the top.



New Zeppelin Rail Car Tested in Germany

RAILROADS have long been the target of mud-slingers, particularly government - owned railroads. Because railroads represent such an enormous capital investment, a very considerable delay must inevitably occur before they can adopt new innovations. When faced with proposed charges a railroad must (or should) first of all consider the effect of such changes upon the safety of the lives of passengers. One of the next most important considerations is speed. Finally, after a new device has passed all its tests, comes the long delay while the necessary financial arrangements are being made to replace obsolete equipment with the new device, or devices. These factors, combined, tend to make the policy of a railroad appear ultra-conservative and sluggish.

It comes as somewhat of a shock, therefore, to learn that the Reichsbahn (the German State Railway) has itself produced and is experimenting with a new type of railroad car which bids fair to completely revolutionize the entire structure of railroad travel as we have known it up to the present.

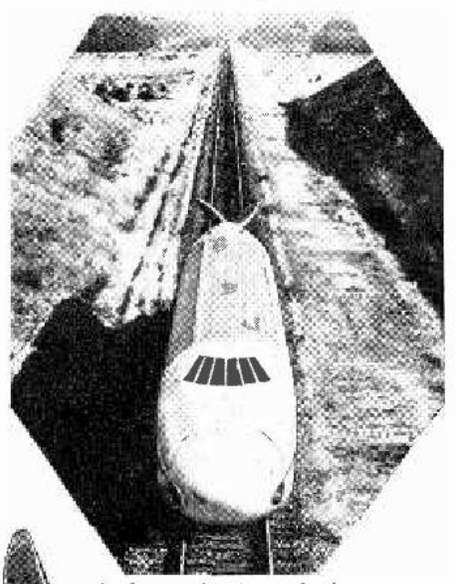
The new car, which is the product of Dr. Franz Kruckenberg and his associates in the Hanover Traffic Experimental Laboratory, is a long, silver-gray, cigar-shaped coach, closely resembling a Zeppelin airship. It measures 85 feet in length overall, and is powered by a 400 H.P. airplane motor which drives a four-bladed airplane propeller. During recent public tests the vehicle attained a speed of 60 M.P.H. within sixty seconds of a standing start, and 100 M.P.H. a few seconds later. In earlier secret trials the car is said to have reached a maximum speed of 114 M.P.H.

Two types of brakes are fitted, railway and automobile, and these brought the car to a smooth stop at the end of the test, which was run over a section of line nine miles long between Celle and Hanover which is completely straight throughout its length and used only for experimental purposes. It was over this stretch of track that the Opel rocket rail car was tested.

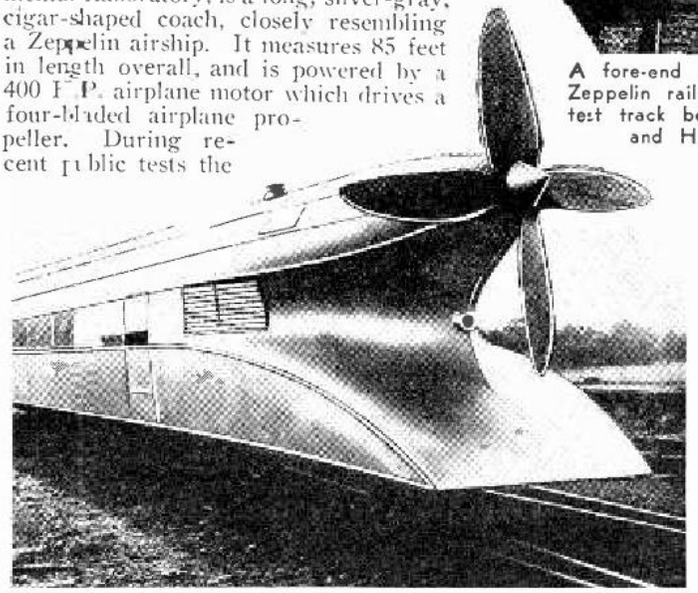
The car weighs 20 tons only, and has room for forty passengers in comfortable parlor car chairs. A single pair of wheels fore and aft supports the body on axles placed sixty-five feet apart. The springing of the car is said to be so smooth that absolutely no vibration or "train feeling" can be observed; the car flashes along as if it were an aerial and not an earthbound vehicle. The rigorous application of the modern principles of streamlining has contributed very largely to the great speed of the car, in addition to the light construction which has been followed throughout.

The shaping of the fore and aft ends of the car tends, at speed, to press the car down on to the rails, as also does the propellor, the shaft of which is mounted with a slight upward tilt. But for this downward pressure, there would be a tendency for the car to leave the rails. Just how the new Zeppelin rail car will behave on curves is yet to be determined, but according to theoretical calculations, it should be able to negotiate all ordinary railroad curves in perfect safety.

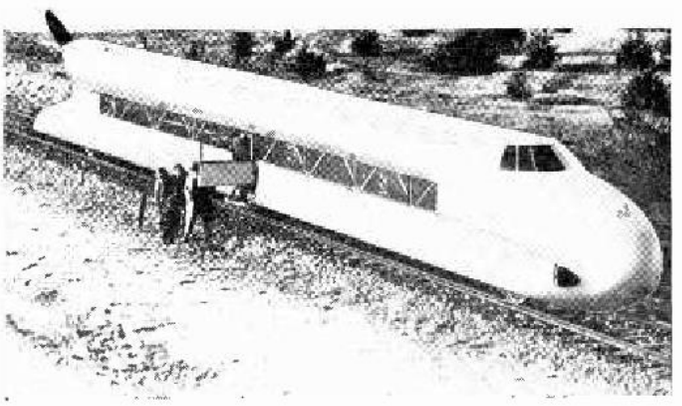
If the new cars are finally introduced into service, they will have to be run singly, at frequent intervals like trolley cars, and not in trains as is done with present railroad cars.



A fore-end view of the Zeppelin rail car on the test track between Celle and Hanover.

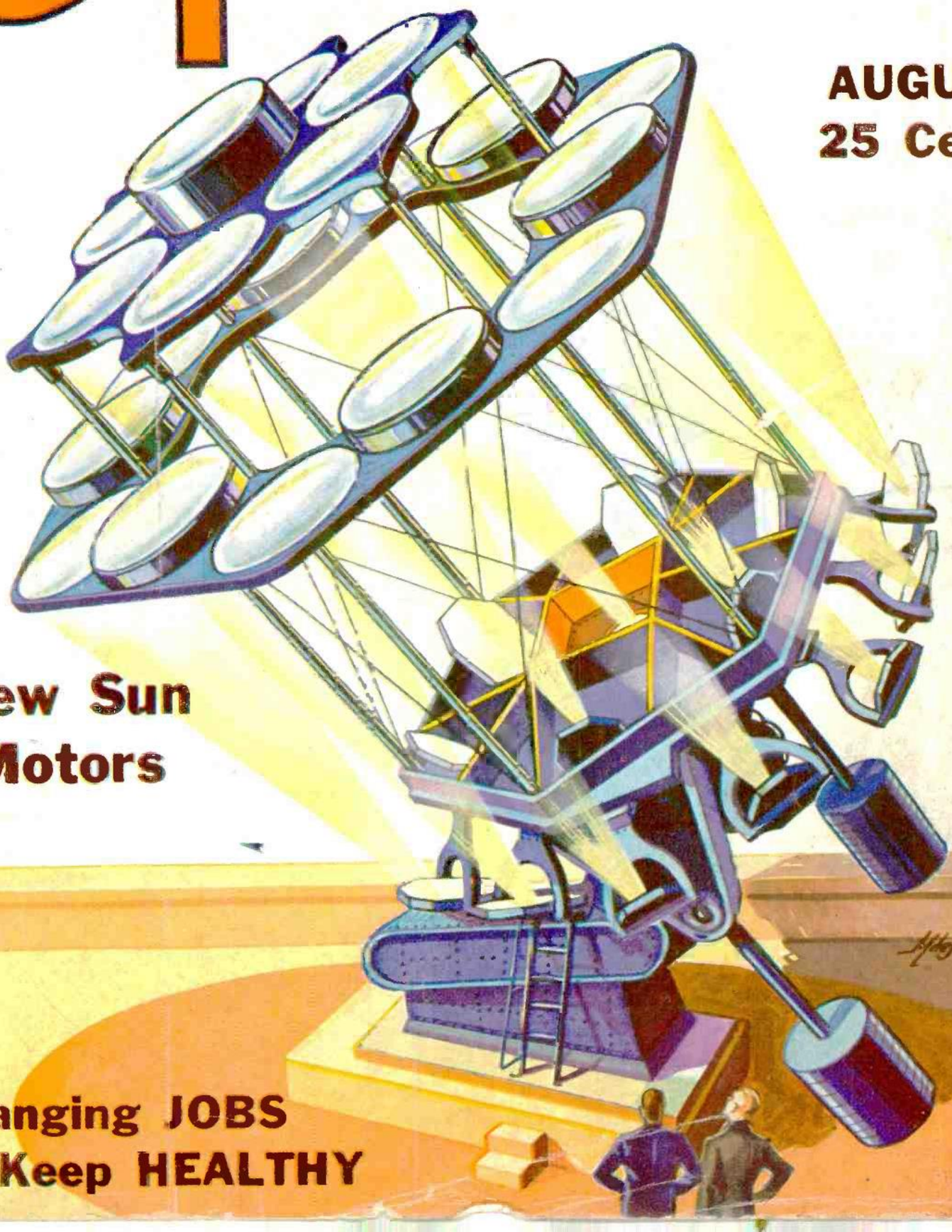


Stern view of the car, showing propeller and streamline shape which tends to press the car down on to the rails when travelling at high speed.



Showing entrance door. The streamline shape of the nose and the tail tends to press the car down. At top of page is a broadside view of the car.

Science and Invention



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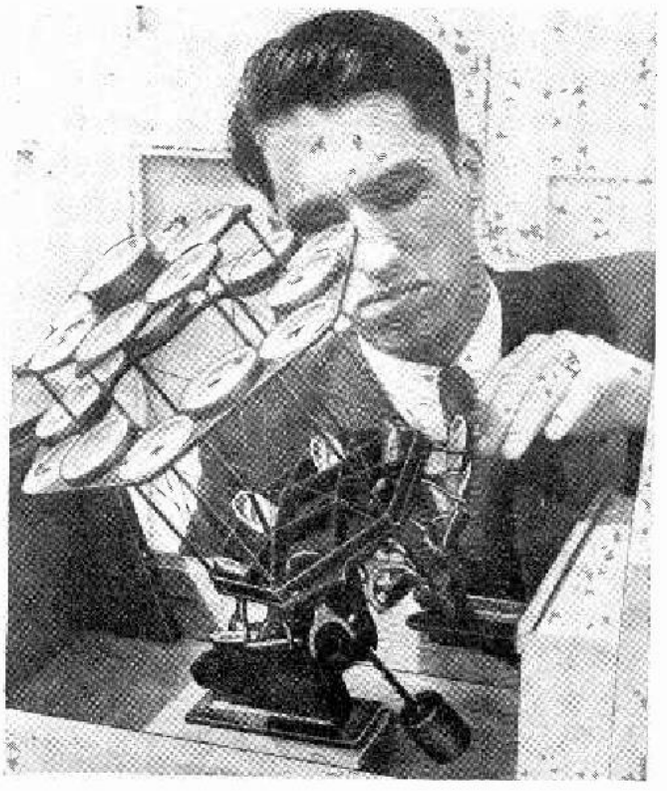
The Sun Pours Forth Millions of Horsepower Every Minute of the Day. So Far, We Have Made Only Indirect Use of This Enormous Energy, in the Form of Coal, Oil and Water Power. Scientists Have for Long Been Making Attempts to Harness the Sun's Power Direct, But So Far Without Commercial Success. Some Suggested Methods for Utilizing the Sun's Heat Are Made Here

By Thomas Elway

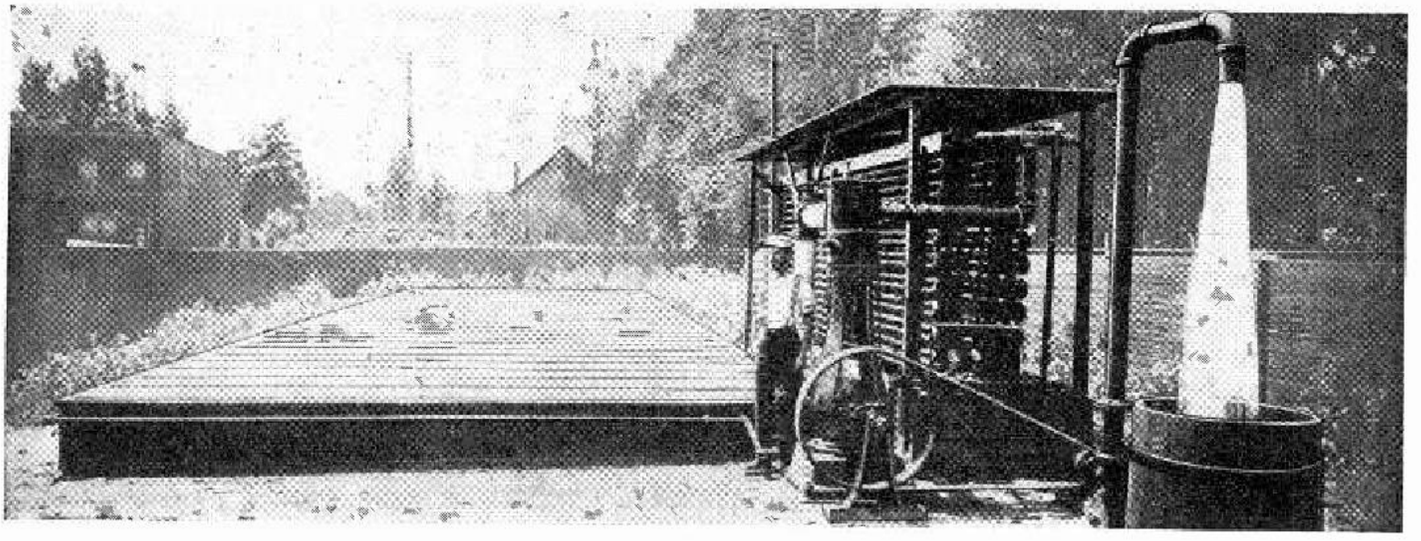
BRINGING the sun to Pasadena to make liquid diamonds, or to strip atoms of their coats of electrons so that scientists can learn more about the structure of matter, is the latest enterprise of scientists at the California Institute of Technology. Nor do the possibilities of this enterprise stop with the fusion of elements or the disruption of atoms made possible by the concentrated solar heat, for the devices to be used may give new life to the age-old problem of obtaining free power from sunlight.

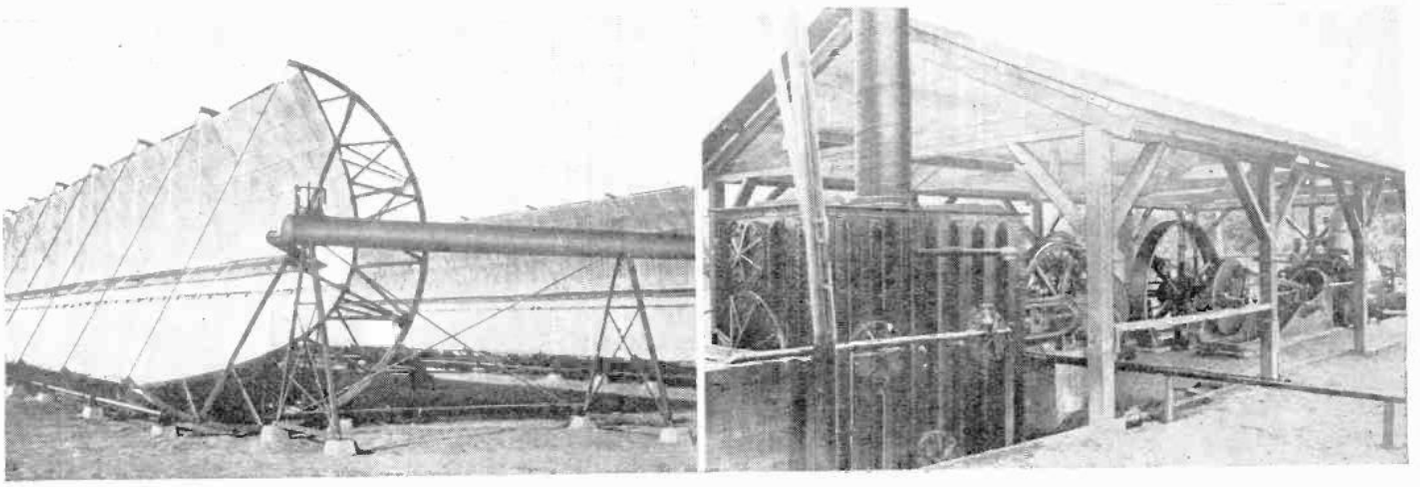
The apparatus which the California physicists are now constructing is designed primarily to produce solar heat, rather than solar power. In many ways it is solar heat with which physicists are most concerned, for ample sources of power are available anyway in such forms as water power, coal or oil. Earthly laboratories are entirely lacking, on the other hand, in means for producing continuous degrees of heat even approximately as great as the heat of the sun's surface, or as great as the new apparatus for controlling solar rays may possibly provide.



A model of a solar furnace which may melt diamonds, built by scientists of the California Institute of Technology, Pasadena. Each of the 19 lenses sends its ray to a common focal point at the base of the instrument. Below—An experimental sun engine using sulphuric ether as the working fluid.

The hottest furnaces ordinarily used on earth run only to some 2000 or 3000 degrees, Fahrenheit. Temperatures about twice as great as this can be obtained, under favorable circumstances, in the centers of electric arcs. Many years ago Benjamin Franklin devised another method of obtaining very high temperatures, by passing large quantities of electricity suddenly through thin metallic wires or strips of metal foil. When this happens the wire or foil explodes violently, producing for a tiny fraction of a second temperatures recently computed by Dr. J. A. Anderson of Mount Wilson Observatory, to reach perhaps 30,000 or 40,000 degrees. It is by means of this method that Dr. Anderson and his colleagues have obtained much of the present-day information about the structure of atoms, but unfortunately these electric temperatures last for only a thousandth of a second or less, so that substances cannot be exposed to them for any length of time.





Left—Side view of one of the sun-power boilers, heated by sun's rays reflected by the parabolic mirrors, which is used to generate power for irrigation pumps in Egypt. The inclination of the mirrors is slowly altered through gearing so that at all times of the day they face the sun. Right—View of the engine shed, from the irrigation pump end.

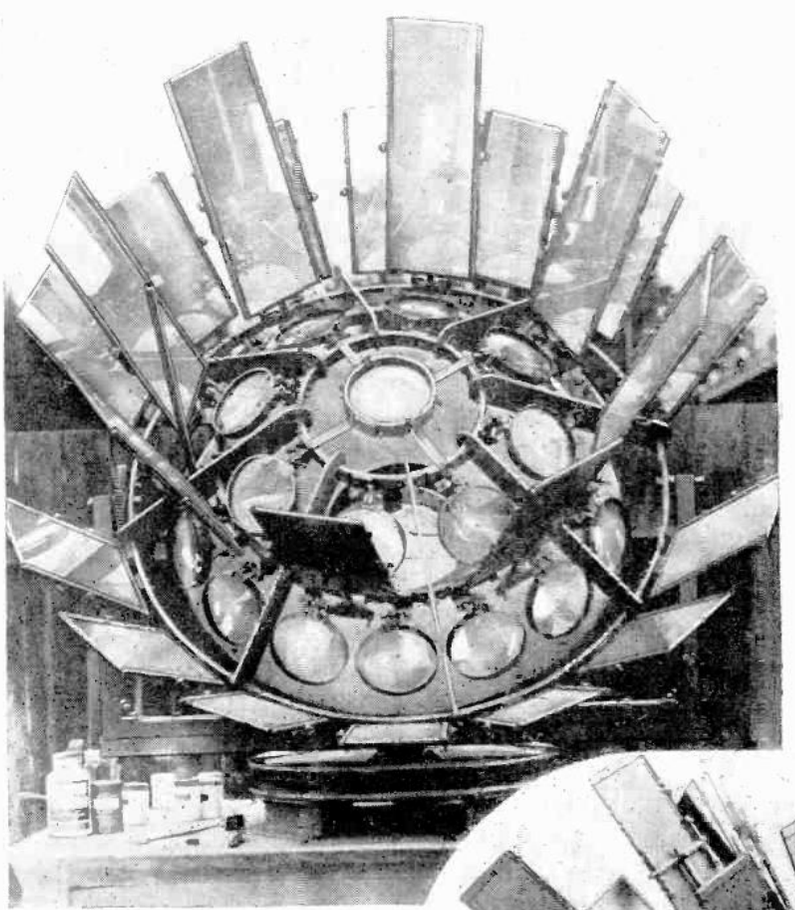
The surface of the sun, on the other hand, has an enormously greater temperature and maintains that temperature continually, thanks to vast amounts of radiant energy generated inside the sun which flow outward continually through its mass. The most recent measurement of the temperature of the sun's surface, communicated last winter to the American Astronomical Society by Miss Charlotte E. Moore, also of Mount Wilson Observatory, places this temperature at 9,869 degrees Centigrade, equivalent to nearly 18,000 degrees Fahrenheit. This is somewhat greater than the usual estimates, but is probably correct. In any event, the surface of the sun unquestionably is far hotter than anything which scientists can duplicate on earth. Things happen to atoms of matter in the sun which do not happen on earth. That is why physicists would like so much to get earthly furnaces approaching the same temperature.

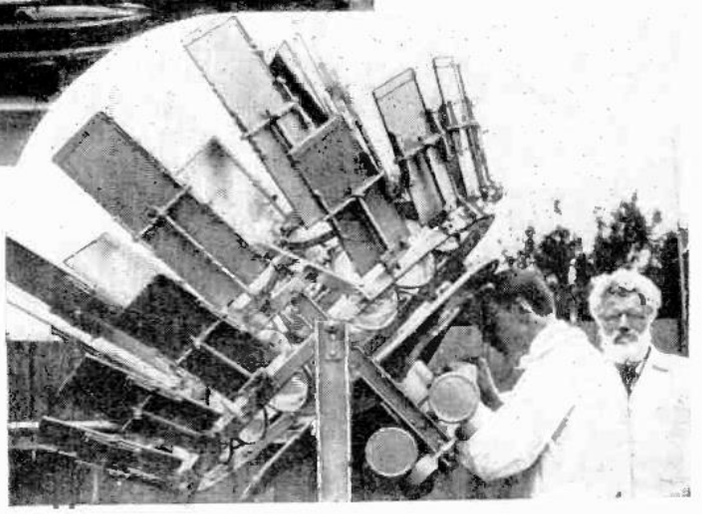
One of the commonest elements, carbon, has never been fused in terrestrial laboratories. A little carbon is vaporized in electric arcs, but droplets of liquid carbon have never been examined because they cannot be produced. No one knows what they would resemble. Perhaps the liquid would be dull and black like solid carbon, or like the graphite of lead pencils. Perhaps, on the other hand, it would be as brilliant and scintillant as a diamond. It is not impossible that *liquid* carbon, could it be produced, might cool into actual diamonds instead of into black carbon grains.

No scientist is much interested in making artificial diamonds to be worn as jewelry, but that is by no means the most important use for these gems. Diamond is the hardest substance known. It has remarkable mechanical, optical and atomic properties. Were it possible to cast fused diamond in laboratories into shapes of scientific or practical utility, enormous advances might be possible in the study of crystals, the handling of the harder metals, and in many other directions. Probably the making of fused carbon, whether or not this becomes fused diamond, will require great pressures as well as great heat. Present resources of earthly laboratories can provide the pressures, but they cannot provide the heat.

One difficulty which prevents the attainment of very great temperatures in ordinary furnaces is that the heat usually is supplied from the outside of the pot or crucible containing the substance that one wants to melt. No known material that might be used for crucibles could resist the enormous heat necessary to fuse carbon. The crucible would melt before the carbon did. A part of this difficulty can be avoided by using the

(*Continued on page* 335)





The above machine, invented by Marcel Moreau, Jr., of San Francisco, catches the rays of the sun, deflects them to a focus by lenses, and creates a heat at that point sufficient to melt refractory substances. Right—The inventor and his father.

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FORMERLY
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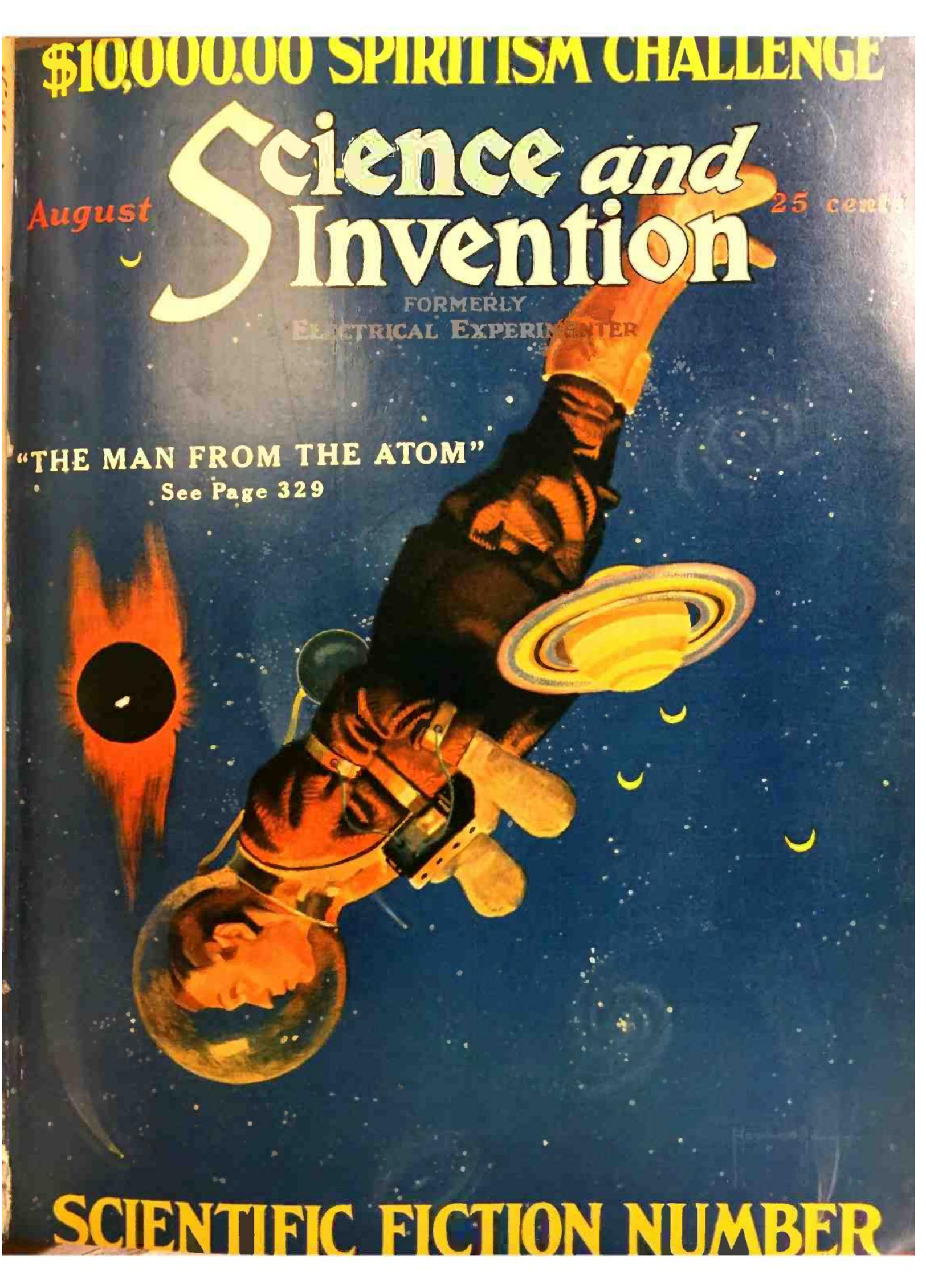
"THE MAN FROM THE ATOM"
See Page 329



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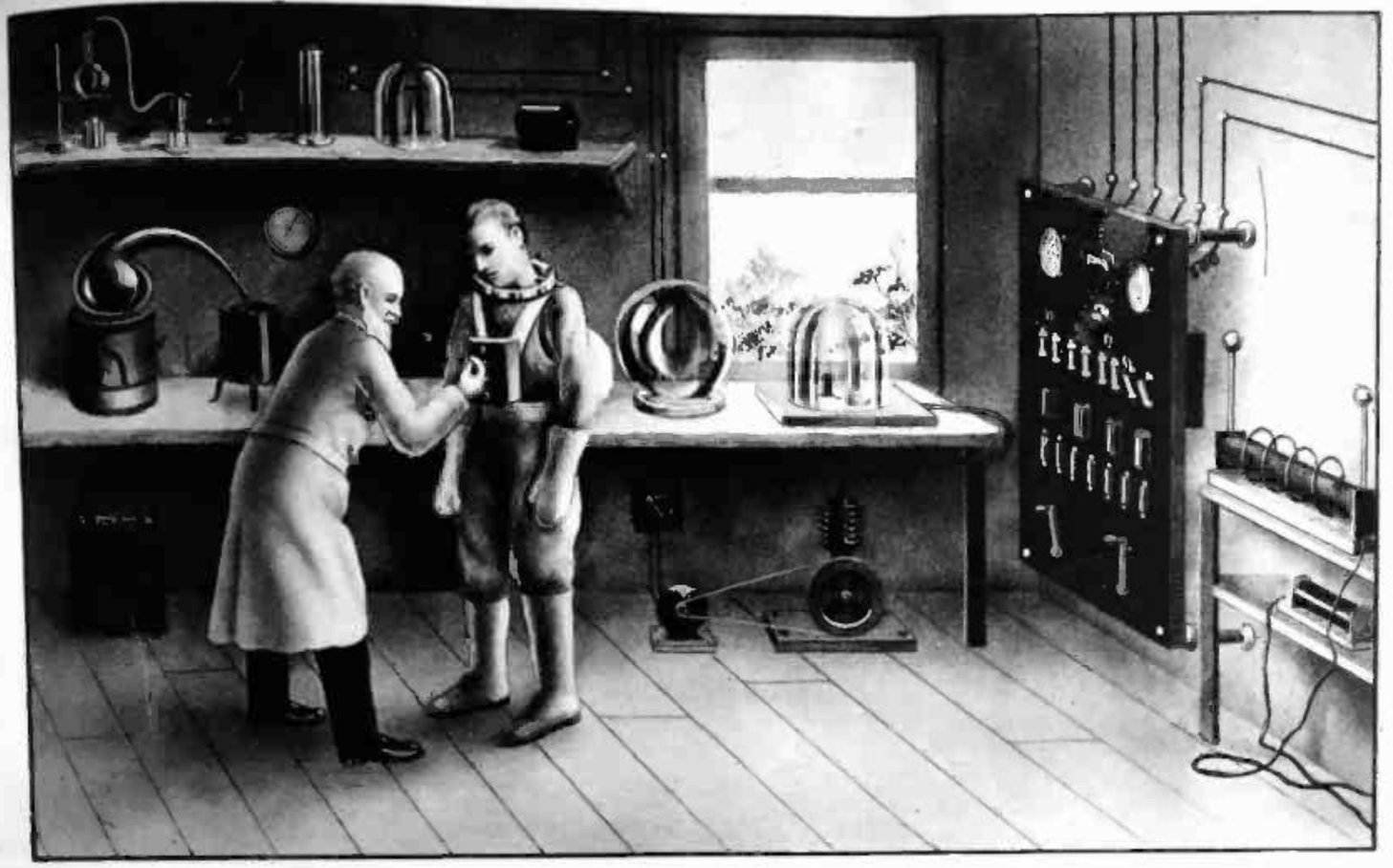

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Fitting On the Apparatus With Which the Professor Hopes to Make Kirby Grow To An Enormous Size, Compared To Whom the Stars Would Seem Like Billiard Balls.

The Man From the Atom

By G. PEYTON WERTENBAKER

I

I AM a lost soul, and I am homesick. Yes, homesick. Yet how vain is homesickness when one is without a home! I can but be sick for a home that has gone. For my home departed millions of years ago, and there is now not even a trace of its former existence. Millions of years ago, I say, in all truth and earnestness. But I must tell the tale—though there is no man left to understand it.

I well remember that morning when my friend, Professor Martyn, called me to him on a matter of the greatest importance. I may explain that the Professor was one of those mysterious outcasts, geniuses whom Science would not recognize because they scorned the pettiness of the men who represented Science. Martyn was first of all a scientist, but almost as equally he was a man of intense imagination, and where the ordinary man crept along from detail to detail and required a complete model before being able to visualize the results of his work, Professor Martyn first grasped the great results of his contemplated work, the vast, far-reaching effects, and then built with the end in view.

The Professor had few friends. Ordinary men avoided him because they were unable to understand the greatness of his vision. Where he plainly saw pictures of worlds and universes, they vainly groped among pictures of his words on printed pages. That was their impression of a word. A group of letters. His was of the picture it presented in his mind. I, however, though I had not the slightest claim to scientific knowledge, was romantic to a high degree, and always willing to carry out his strange experiments for the sake of the adventure and the strangeness of it all. And so the advantages were equal. I had a mysterious personage ready to furnish me with the unusual. He had a willing subject to try out his inventions, for he reasoned quite naturally that should he himself perform the experiments, the world would be in danger of losing a mentality it might eventually have need of.

And so it was that I hurried to him without the slightest hesitation upon that, to me, momentous day of days in my life. I little realized the great change that soon would come over my existence, yet I knew that I was in for an adventure, certainly startling, possibly fatal. I had no delusions concerning my luck.

I found Professor Martyn in his laboratory bending with the eyes of a miser counting his gold over a tiny machine that might easily have fitted in my pocket. He did not see me for a moment, but when he finally looked up with a sigh of regret that he must tear his eyes away from this new and wonderful brain-child, whatever it might be, he waved me a little unsteadily into a chair, and sank down in one himself, with the machine in his lap. I waited, placing myself in what I considered a receptive mood.

"Kirby," he began abruptly at last, "have you ever read your Alice in Wonderland?"

I gasped, perhaps, in my surprise.

"Alice in—! are you joking, Professor?"

"Certainly not," he assured me. "I speak in all seriousness."

"Why, yes, I have read it many times. In fact, it has always struck me as a book to appeal more to an adult than to a child. But what—I can't see just how that is important." He smiled.

"Perhaps I am playing with you unduly," he said, "but do you remember the episode of the two pieces of cheese, if my own recollection is correct, one of which made one grow, the other shrink?"

I assented. "But," I said incredulously, "certainly you cannot tell me you have spent your time in preparing magical cheeses?" He laughed aloud this time, and then, seeing my discomfort, unburdened himself of his latest triumph.

"No, Kirby, not just that, but I have indeed constructed a machine that you will be incapable of believing until you try it.

(Continued on page 386)

IF you are interested in Einstein's Theory of Relativity, you cannot afford to miss this story. It is one of the big scientific stories of the year and is worth reading and rereading many times. If the Theory of Relativity has been a puzzle to you, this story, written in plain English, cannot fail to hold your interest from start to finish. The thoughts expressed in this story are tremendous. It will give you a great insight, not only into the infinitely large, but also the infinitely small. Better yet, relativity is brought home to you in a most ingenious and easily understandable manner.—EDITOR.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 19
The Secret of the Super-Telescope

(AUTHOR'S NOTE.—*Shall we ever be able to make telescopes sufficiently powerful to reveal living beings on the moon, if any such exist. Unquestionably, yes; and in my opinion the thing would not be impossible at the present day, by successive magnification, using due care to reduce distortions to a minimum and illuminating each successive image to make up for the loss of light at each illumination. The fact that we have found neither air nor water on the moon is by no means proof that living beings of some sort do not dwell there.*)

"SILAS," said Doctor Hackensaw, impressively, "I'm going to reveal to you another of my secrets to-day, one that may have far-reaching consequences and prove of greater importance than any of my other inventions. I am going to let you have a look through my super-telescope."

"You have invented an improved telescope?"

"'Yes' and 'No' to that question. In reality I have devised a new instrument to take the place of the telescope, and far superior to the latter in its power of magnifying bodies without detracting from their clearness. I spent many years trying to improve our present telescope, but only with partial success. I began by offering fabulous sums to a celebrated firm of opticians if they would produce for me a telescope far superior to any before made. The result was almost nil. A big bill to pay and nothing to show for it. Not a single new discovery of any consequence resulted. I then decided to take matters into my own hands, break loose from tradition, and start on a new tack. A telescope is nothing but a magnifying instrument, and there seemed to me no reason why the image of a star or planet could not be received on a mirror and then magnified to any desired extent.

SEVERAL PROBLEMS TO SOLVE

"Of course there were several problems to solve: 1. As each magnification diminishes the light, there must be means of increasing the original light received from the star or planet itself. 2. Every refraction, and hence every magnification, produces a certain amount of distortion in the image, the distortion of course increasing with each increase of size. This distortion must be reduced to a minimum or my telescope would be worthless. 3. Refraction is not the same for light of different colors. Hence at each magnification there is a tendency for the light to separate into all the colors of the rainbow. This is known as "chromatic aberration and must be guarded against. 4. Any imperfection in the lenses themselves, or any impurities in the earth's atmosphere will be greatly magnified. These are the four principal troubles.

TELESCOPE IMAGE ENLARGED IN SUCCESSIVE STAGES

"I accordingly used the following method. I received the first magnified image of the moon on a mirror. This mirror I illuminated by a powerful electric light, and then threw a magnified image from this on a screen, which was in reality a second mir-

(*Continued on page 393*)

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Silas Somewhat Skeptically Took a Seat Before the Television Screen and Waited While Doctor Hackensaw Adjusted His Instruments. And Then the Reporter Gave a Cry of Surprise, for There Appeared on the Screen a Picture Unlike Anything He Had Ever Imagined. "That," Explained the Doctor, "Is a Small Portion of the Moon's Surface. It Is Somewhat Hazy and Distorted, Due to the Tremendous Magnifying Power Used, But It Is Sufficient to Give You a Tolerably Clear Idea of Conditions on the Moon."

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"Hello-o!" Tubby Called Incautiously. The Girl Sprang Erect; and Stood Trembling, Lyre in Hand, as They Hurried Forward. Tubby Saw She Was a Rather Small, Very Slim Girl, Dressed in a Flowing White Garment from Shoulder to Knee, Which was Gathered at the Waist with a Golden Cord Whose Tasseled Ends Hung Down Her Side. Her Bare Feet Were Sandaled; Her Arms Were Bare. Her Glossy Black Hair, Gathered at the Neck with a Single Golden Loop, Hung in Profusion Nearly to Her Waist. Her Face Was Delicately Oval—Her Cheeks a Pure Pink-White; Her Mouth Was Small, Her Lips Prettily Bowed. Her Dark Eyes, Which Had Long Black Lashes, Were at the Moment Wide With Surprise and Fear. She Stood as though About to Dash Away—a Startled Nymph Hesitating Before Flight.

Around the Universe

By RAY CUMMINGS

SECOND INSTALLMENT

CHAPTER III

IN WHICH TUBBY AND SIR ISAAC MEET THE VENUS-GIRL AND LEARN OF THE PLOT TO DESTROY THE EARTH

TUBBY had gone to sleep in the starlight and very dim moonlight. He awoke, most uncomfortably warm, to find the glaring sunlight beating directly on his bed through the bedroom window. For a moment he did not know where he was. The sun, larger than he had ever seen it before, was about level with the window—shining among the stars in the black sky, intolerably bright, excessively hot. He lay blinking and gasping; then with returning memory, he leaped out of bed and jerked down the green roller shade.

The vehicle was without vibration, silent as before. The room was hotter than midsummer. Where was the professor? Was anything wrong? What time was it?

"Oh-h, perfessor!" Tubby bellowed.

Sir Isaac's voice answered him from below.

"Oh, you're awake, are you? Come on down. Dress as coolly as possible."

Tubby was dressed in a few moments, putting on his thinnest clothes—white flannel trousers, white buckskin shoes and white negligee shirt—which he had found in the bureau drawers and the wardrobe. He was glad to find them there, and glad that they fitted him so perfectly, for he wanted to look his best when arriving on Venus.

When he got downstairs he found Sir Isaac also dressed all in white, with his shirt sleeves rolled up and his shirt open at the throat exposing half his boney but broad chest. Around his forehead was tied a white silk handkerchief to keep the hair out of his eyes. He was sitting at the instrument room table, working at his interminable figures.

The side window of the room, which was now turned away from the sun, showed only the black void of space with its glittering stars. Through another window, in the floor directly under Sir Isaac's feet—which Tubby had not known to be there since it had been covered the night before—a soft, pale-blue light was streaming. It flooded the entire room, more intense than moonlight, but blue rather than silver.

Sir Isaac looked up from his calculations and smiled.

"Good morning. I was just coming up to call you."

"The sun woke me up," said Tubby. "It's awful hot up there. . . . It ain't so cool down here either. . . . What's that blue light from? How are we gettin' on? What time is it?"

Sir Isaac laid down his pencil reluctantly.

"Seven thirty-three," he said. "You've had a good long sleep. I just altered our course again. We intersected the orbit of Venus twenty-seven minutes ago, so I thought I had better turn and head directly for her. That's why the sun swung up to your window."

Tubby hung his natty Panama hat on a rack and approached Sir Isaac.

"What's that blue light? Venus?"

Looking down through the window, Tubby saw directly beneath them an enormous blue half moon, with dark, irregular patches all over it. Against the black background of space it glowed with intense purity—its pale-blue light making it seem ethereal—unreal.

"That is Venus," said Sir Isaac softly. "You can see the whole of the sphere when your eyes become accustomed to the light."

A moment more and Tubby saw the dark, unilluminated portion. He saw, too, that where the edge of the light crossed the face of the globe, it was not a continuous line, but was broken into many bright spots and patches of darkness.

(*Continued on page 398*)

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Miraculously Professor Carbonic Opened His Eyes, and Rose To His Feet. His Eyes Were Like Balls of Fire; His Lips Moved Inaudibly, and As They Moved Little Blue Sparks Were Seen To Pass From One To Another. His Hair Stood Out From His Head. The Chemical Reaction Was Going On In the Professor's Brain, With a Dose Powerful Enough To Restore Ten Men. He Tottered Slightly.

Advanced Chemistry

By JACK G. HUEKELS

PROFESSOR CARBONIC was diligently at work in his spacious laboratory, analyzing, mixing and experimenting. He had been employed for more than fifteen years in the same pursuit of happiness, in the same house, same laboratory, and attended by the same servant woman, a negress, who in her long period of service had attained the plumpness and respectability of two hundred and ninety pounds.

"Mag Nesia," called the professor. The servant's name was Maggie Nesia—Professor Carbonic had contracted the title to save time, for in fifteen years he had not mounted the heights of greatness; he must work harder and faster as life is short, and eliminate such shameful waste of time as putting the "gie" on Maggie.

"Mag Nesia!" the professor repeated.

The old negress rolled slowly into the room.

"Get rid of these and bring the one the boy brought today."

He handed her a tray containing three dead rats, whose brains had been subjected to analysis.

"Yes, Marse," answered Mag Nesia in a tone like citrate.

The professor busied himself with a new preparation of zinc oxide and copper sulphate and sal ammoniac, his latest concoction, which was about to be used and, like its predecessors, be abandoned.

Mag Nesia appeared bringing another rat, dead. The professor made no experiments on live animals. He had hired a boy in the neighborhood to bring him fresh dead rats at twenty-five cents per head.

Taking the tray he prepared a hypodermic filled with the new preparation. Carefully he made an incision above the right eye of the carcass through the bone. He lifted the hypodermic, half hopelessly, half expectantly. The old negress watched him, as she had done many times before, with always the same pitiful expression. Pitiful, either for the man himself or for the dead rat. Mag Nesia seldom expressed her views.

Inserting the hypodermic needle and injecting the contents of the syringe, Professor Carbonic stepped back.

PROF. CARBONIC MAKES A GREAT DISCOVERY

"Great Saints!" His voice could have been heard a mile. Slowly the rat's tail began to point skyward; and as slowly Mag Nesia began to turn white. Professor Carbonic stood as paralyzed. The rat trembled and moved his feet. The man of many years made one jump with the alacrity of a boy of sixteen, he grabbed the embryonic animal, and held it high above his head as he jumped about the room.

Spying the negress, who until now had seemed unable to move, he threw both arms around her, bringing the rat close to her face. Around the laboratory they danced to the tune of the negress's shrieks. The professor held on, and the negress recov-

(Continued on page 378)

WE are certain that you will enjoy "Advanced Chemistry." It is a satire that cannot fail to amuse you. While Mr. Huekels has treated the subject lightly and is poking fun at our scientists, nevertheless, there is more truth than satire in his story.

For the up-to-date scientist today is pretty well convinced that all chemical, as well as physiological actions, have their origin in the electric current. We are certain you will like this story.—EDITOR.

July

25 Cents

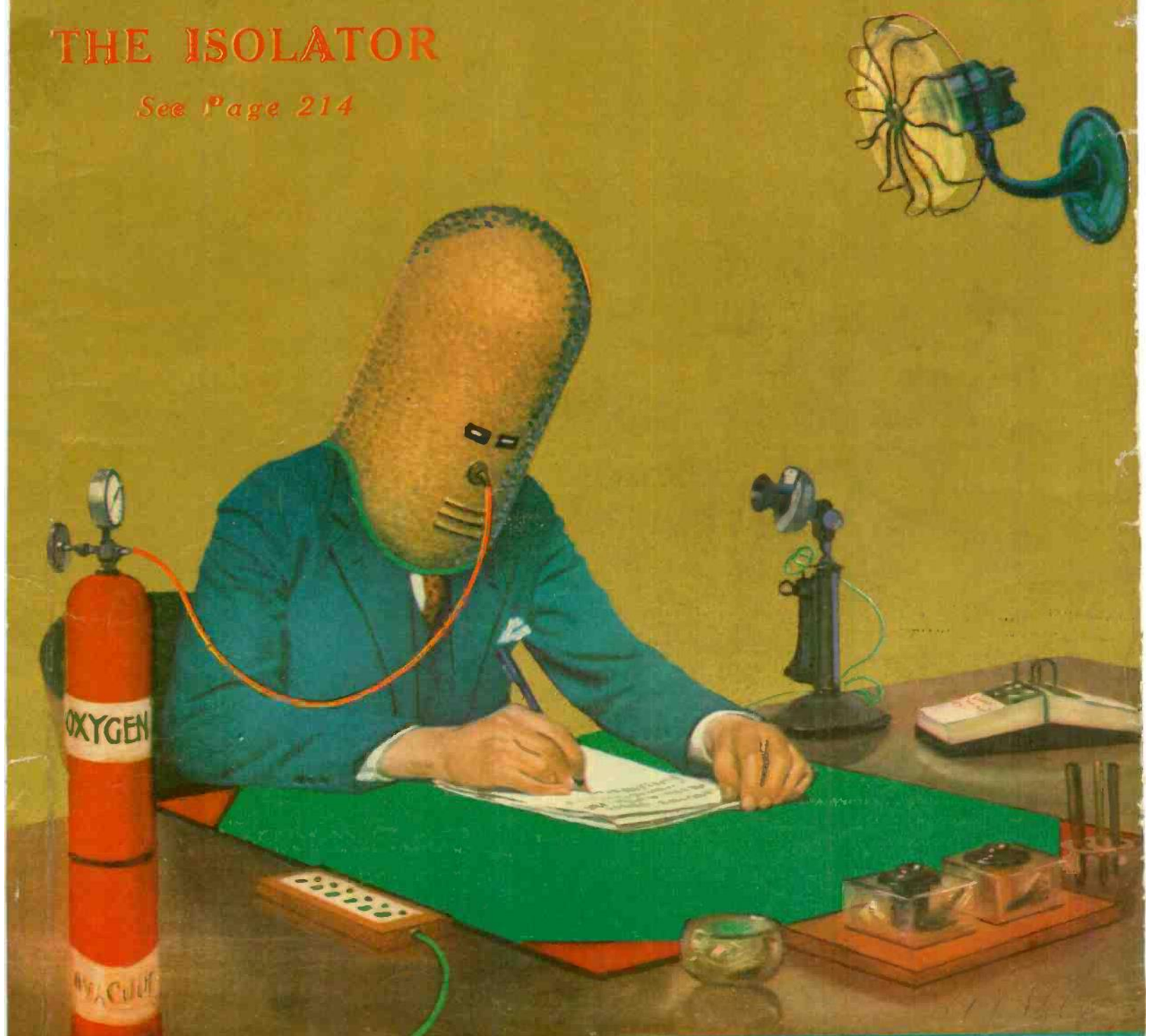
Science and Invention

IN PICTURES

40 NON-TECHNICAL RADIO ARTICLES

THE ISOLATOR

See Page 214



EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
RADIO NEWS - SCIENCE & INVENTION - THE EXPERIMENTER - MOTOR CAMPER & TOURIST

The Isolator

By HUGO GERNSBACK
MEMBER AMERICAN PHYSICAL SOCIETY

The author at work in his private study aided by the Isolator. Outside noises being eliminated, the worker can concentrate with ease upon the subject at hand.

PERHAPS the most difficult thing that a human being is called upon to face is long, concentrated thinking. Whether you are a lawyer, trying to formulate or memorize the pleading of a special case, whether you are an inventor with an intricate problem to be solved, whether you are a playwright trying to hatch out a knotty plot—assiduous concentration on the subject becomes necessary.

Most people who desire thus to concentrate find it necessary to shut themselves up in an almost soundproof room in order to go ahead with their work, but even here there are many things that distract their attention.

Suppose you are sitting in your study or your work room, ready for the task. Even if the window is shut, street noises filter through, and distract your attention. Some one slams a door in the house, and at once your trend of thought is disturbed.

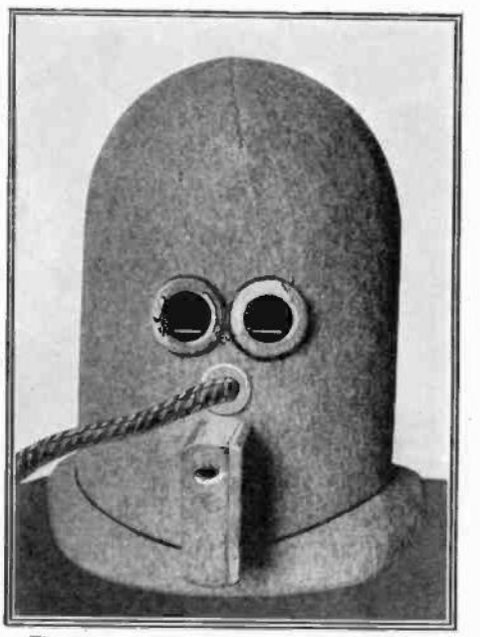
A telephone bell or a door bell rings somewhere, which is sufficient, in nearly all cases, to stop the flow of thought.

But even if supreme quiet reigns, you are your own disturber practically fifty per cent. of the time. You will lean back in your chair and begin to study the pattern of the wallpaper, or you will see a fly crawl along the wall, or a window curtain will be moving back and forth, all of which is often sufficient to turn your mind away from the immediate task to be performed.

The writer repeats that the greatest difficulty that the human mind has to contend with is lack of concentration, mainly due to outside influences.

If, by one stroke, we can do away with these influences, we will not only be benefitted greatly thereby, but our work would be accomplished more quickly and the results would be vastly better.

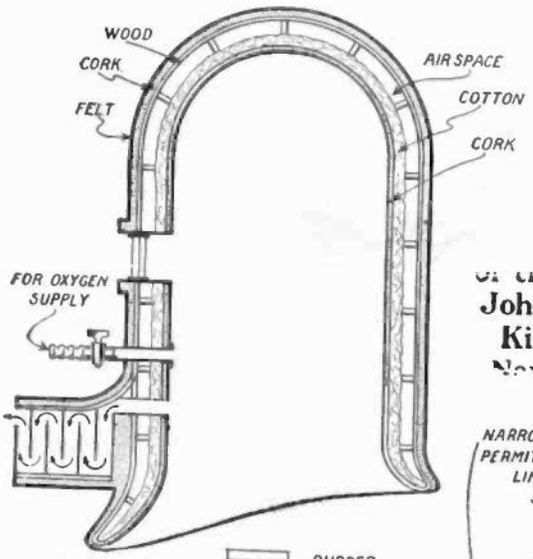
The writer, who has to perform, almost daily, in connection with his editorial duties, many tasks that involve considerable concentration, has found out that it is almost impossible to keep his mind on a subject for five minutes without disturbance. For that reason, he constructed the helmet shown in the accompanying illustrations, the purpose of which is to do away with all possible interferences that prey on the mind.

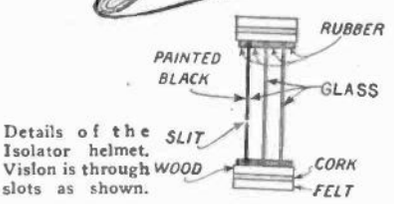


The above photograph shows a close-up view of the Isolator helmet. The oxygen supply enters the helmet via the tube shown.

The problem was first to do away with the outside noise. The first helmet constructed as per illustration was made of wood, lined with cork inside and out, and finally covered with felt. There were three pieces of glass inserted for the eyes. In front of the mouth there is a baffle, which allows breathing but keeps out the sound. The first construction was fairly successful, and while it did not

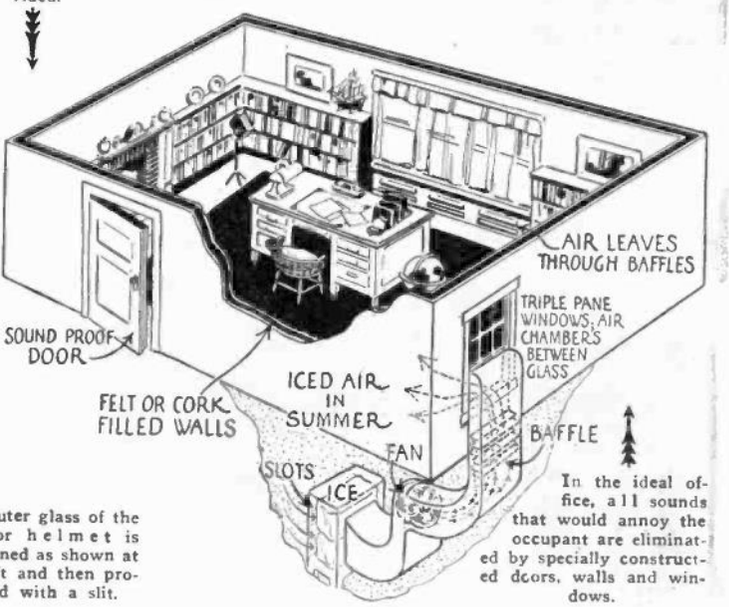
(*Continued on page* 281)



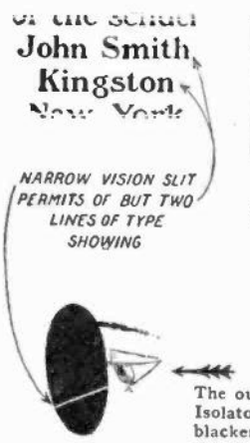


Details of the Isolator helmet. Vision is through slots as shown.

Right below: A sectional view of the ideal office or study where work requiring concentration is to be performed. Every device for the comfort of the occupant is provided.



In the ideal office, all sounds that would annoy the occupant are eliminated by specially constructed doors, walls and windows.

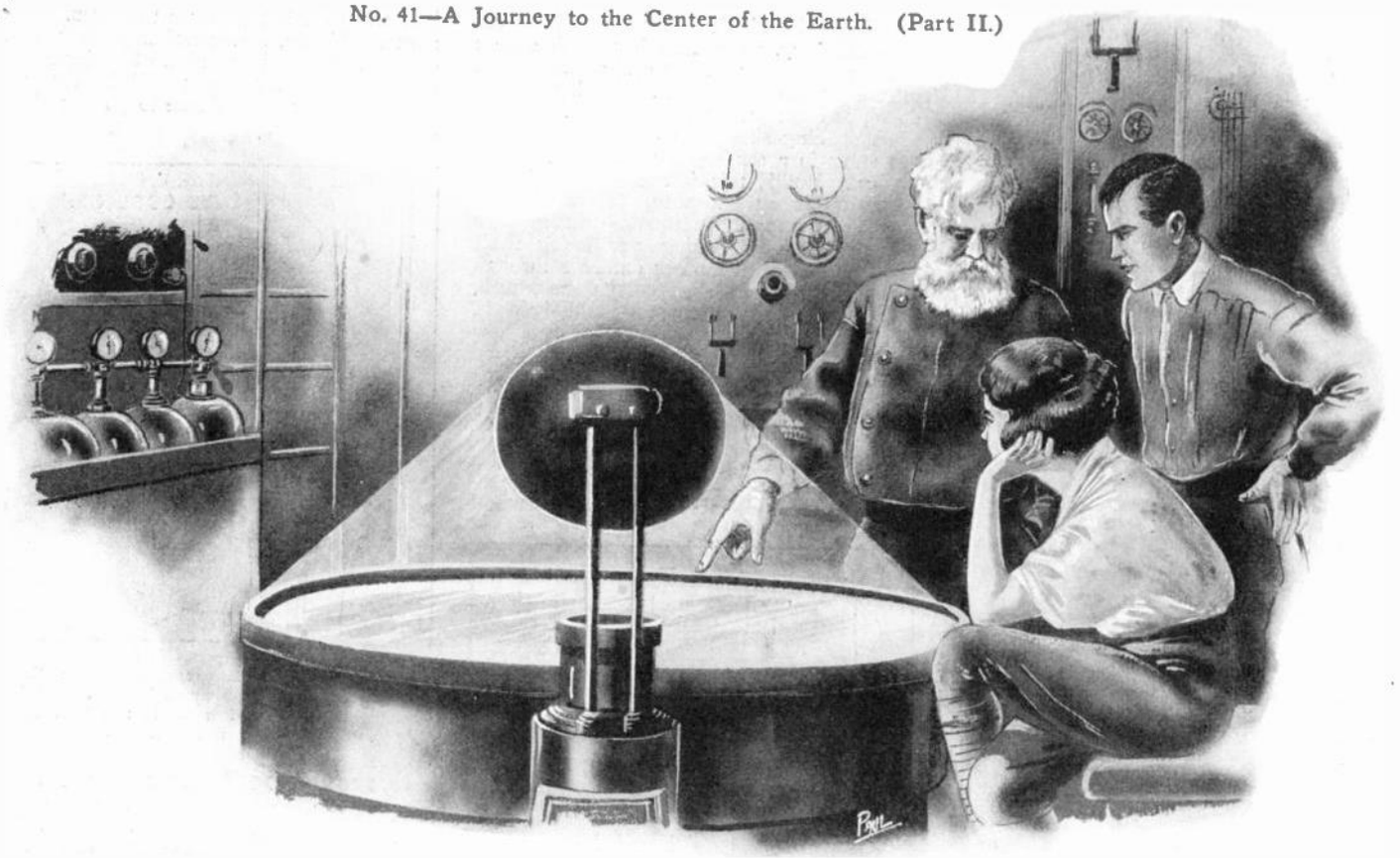


The outer glass of the Isolator helmet is blackened as shown at the left and then provided with a slit.

Doctor Hackensaw's Secrets

By CLEMENT FEZANDIÉ

No. 41—A Journey to the Center of the Earth. (Part II.)



Dr. Hackensaw, Pep and Miggs seated within the reconstructed "Dart" on its journey to the center of the earth. Dr. Hackensaw is pointing downward through the observation glass through which the progress of the car can be watched. The searchlight is directed downward.

SYNOPSIS OF PART I.

DR. HACKENSAW after having determined to explore the center of the earth and having made preliminary observations, asks his very good friend Pepita Perkins, a newspaper reporter, to accompany him on a trip to the South Pole where the excavation was to be started for the trip to the center of the earth. They arrive at Dr. Hackensaw's village at the South Pole where a crevice in the earth five miles deep has been discovered. Working first with a diamond drill and then with an "atomic force drill," one of Dr. Hackensaw's inventions, they start work on the bottom of the pit. After some hours of drilling, observations made by means of a special microphone show that they are nearing another natural cavern in the interior of the earth. The diamond drill is once more brought into play and soon pierces the remaining shell of the rock into the lower cavity in which a partial vacuum is found to exist. A concussion bomb dropped into this cavity proves, by measuring the time it takes for the sound of explosion to reach the observers, that the cavern is over 100 miles deep.

CHAPTER IV

"JERUSALEM!" exclaimed Doctor Hackensaw. "This hundred-mile pit will save us a lot of digging, but it forces us to change our plans immediately. Evidently a partial vacuum exists in this pit, and our first step must be to ascertain exactly what degree of vacuum exists. Luckily this will be easy, as I have a couple of special Geissler tubes with me, so constructed that air may be admitted or pumped out at will. One of these tubes I shall open and let down into the pit. The rarefied atmosphere of the pit and that in the tube will soon equalize. By passing an electric current through the tube and comparing the fluorescence with that of the second tube, into which I can admit more or less air until the two tubes emit an equal amount of light, I shall know that the vacuum in the pit is exactly equal to that in the second tube."

The experiment was tried, but when the result became known, Doctor Hackensaw shook his head.

"The air density in the pit is really very slight," he exclaimed. "In one way, of course, this is an advantage, for it will relieve us of the danger of encountering an enormous air pressure down below. But on the other hand it will make the start difficult."

"Couldn't you let in more air?" asked Pep.

"Certainly, and I should unhesitatingly do so if I were convinced the pit were only a hundred miles deep. I believe it to be much deeper, however."

"But you said the bomb exploded one hundred miles below the surface!"

"So it did, but it may have struck the side of the pit, or it may even have been set off by the compression of the air in front of it. However, to save time we'll do a little exploring. The electric aeroplane, "The Dart," is provisioned for six months and has an oxygen supply sufficient for three months. Accordingly, if we are prudent we have little to fear. What I shall do will be to provide some twenty-five or more miles of light but strong chain, fasten them to the rear of the aeroplane and let the car slowly down so we can examine the pit a little. To aid in this work I shall have some suits made in the style of light diving suits. These will be provided with suction-boots made on the principle of a fly's feet—the suction enabling me to walk down the sides of the pit without danger of falling, just as a fly walks head downwards on a ceiling."

"Gee!" cried Pep. "Make a pair of those boots for me, too! But won't it be tiresome to hold our bodies stiff?"

"No, I shall have a metal framework made to wear under our clothing. The whole weight of our bodies will thus be borne by the metal frame and not by our muscles. Of course, we shall not be able to use these suction boots so long as the air in the pit is so rarefied. It requires normal atmospheric pressure to make sufficient suction. We can only use the boots in case the pressure is greater down below or in case I let air from above into the pit.

CHAPTER V

Several weeks were required for the necessary preparations, and Pep was becoming very impatient when one fine day Doctor Hackensaw called to her:

"Pack your bag at once, Pep; we start at noon!"

An hour later, the two, accompanied by Miggs who was to act as pilot for the aeroplane, had descended into the closed chamber ready for the start down into the apparently bottomless pit.

At sight of "The Dart," however, both Miggs and Pep uttered a cry, for the compact spindle-shaped aeroplane they were familiar with now resembled one of the giant squids or octopuses familiar to all movie-fans.

Fastened to the rear of the aeroplane were several long tentacles or arms resembling huge metal springs, set in a circle. It was in fact an almost exact imitation of an octopus. Below was a second set resembling the first.

"What in the world are those arms for?" asked Pep, in surprise.

"Those are to serve as brakes," explained Doctor Hackensaw. "As there is practically no air in this portion of the pit, our car would fall down at a frightful speed if allowed to drop in."

"But I thought the car was to be held back by a chain?"

"So it is, for a short distance. But we cannot place much dependence on the chain, and must soon cast loose from it, anyway. Now I have ascertained that the pit is really a narrow well in the solid rock. As we descend I shall force these metal arms against the sides of the well and so be able to check our descent, or stop completely, at will. An electric equalizer will automatically keep the pressure equal in each arm so that our descent will be steady and uniform. Electric refrigerating devices will keep the ends of the arms from melting through the heat produced by friction against the rock. Should one of the arms become worn or injured, a new arm from below will automatically replace it. I can set the device so that the springs will press against the walls with any degree of pressure I desire.

"But we can't stand here talking. We must get inside the car, for we have a long way to travel and I don't dare to get up too much speed. This will not be a joy ride by any manner of means, for we shall be explorers. I have an excellent searchlight on the car which will reveal our path for a mile or more ahead of us, but it would not pay to be imprudent."

"One moment, doctor!" objected Miggs. "You say that these brakes are needed to hold us back. Couldn't you reverse the propeller and hold the car back that way?"

"Certainly I could if there were normal air at atmospheric pressure in the pit. But there is so little air here that the propeller would have nothing to work against. You cannot push the car backwards unless you've got air or something else to push against."

"All right!" said Miggs. "I understand that and I see that without the brakes we would just drop down into the pit. With the help of the brakes we shall get down all right, but if we can't use the propeller, how in the world are we ever going to get up again?"

CHAPTER VI

Doctor Hackensaw smiled at the boy's question: "Don't be afraid, Miggs," said he. "I am not any more anxious than you are to be left down at the bottom of this hundred-mile hole, without any means of climbing up again. You know the old Latin proverb: *'Facilis decensus Averni!'* It means that it's easy enough to go down, but not so easy to come up. I didn't find it so easy as all that to go down, but in our case it won't be very difficult to come up again."

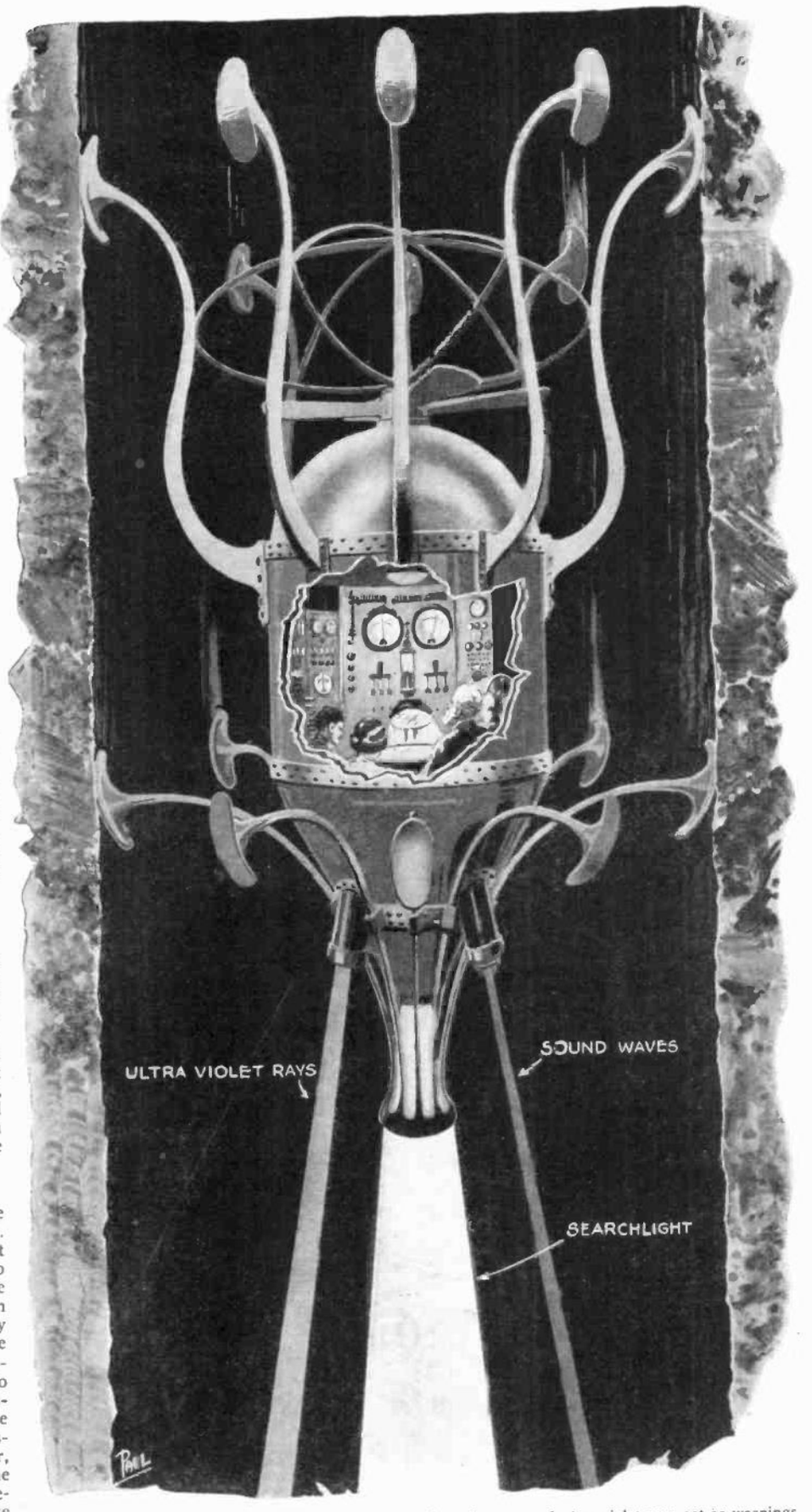
"How will you manage it?"

"Simply enough. The cause of our trouble is that there is almost no air in this pit. The remedy is self-evident. We must let some air in from above, when we wish to return. I have arranged with Mr. Sam, the agent, to let in air by degrees on our return trip. If possible I shall signal to him by radio just when to send in the air. In case anything goes wrong with our radio apparatus, however, he is to let in air enough so that our car shall be always in an atmosphere of about fifteen pounds to the square inch when we return. In such an atmosphere our propeller can easily raise the car, and we can fly back without trouble. If he let in too much air, the pressure down below here would be too great and might cause trouble.

"How can Mr. Sam know where the car is and what pressure it exerts."

"The car is itself a large permanent magnet, and by means of an ingenious amplifying device, its distance from the surface of the earth is indicated on an extra sensitive galvanometer in Mr. Sam's office. But to leave theory and come down to practical matters. There are only three of us in the car, so we must take turns as pilots. Each of us will take a trick of two hours at the controls and then have four hours' rest. There is very little for the pilot to do as everything is arranged to work automatically as much as possible. Yet it is only prudent to have someone constantly on guard. Our searchlight shows the way for more than a mile ahead. There is a smoked glass window for the pilot to look through without being blinded by the rapid flashing by of the illuminated walls.

(*Continued on page 278*)



An external view of the "Dart" on its journey. Sound waves and ultra-violet rays act as warnings in case the car should approach too close to an obstruction. The side of the car is shown broken away revealing the complicated, yet commodious traveling compartment. The curved plates pressing against the sides of the shaft are brakes for regulating the speed.

February

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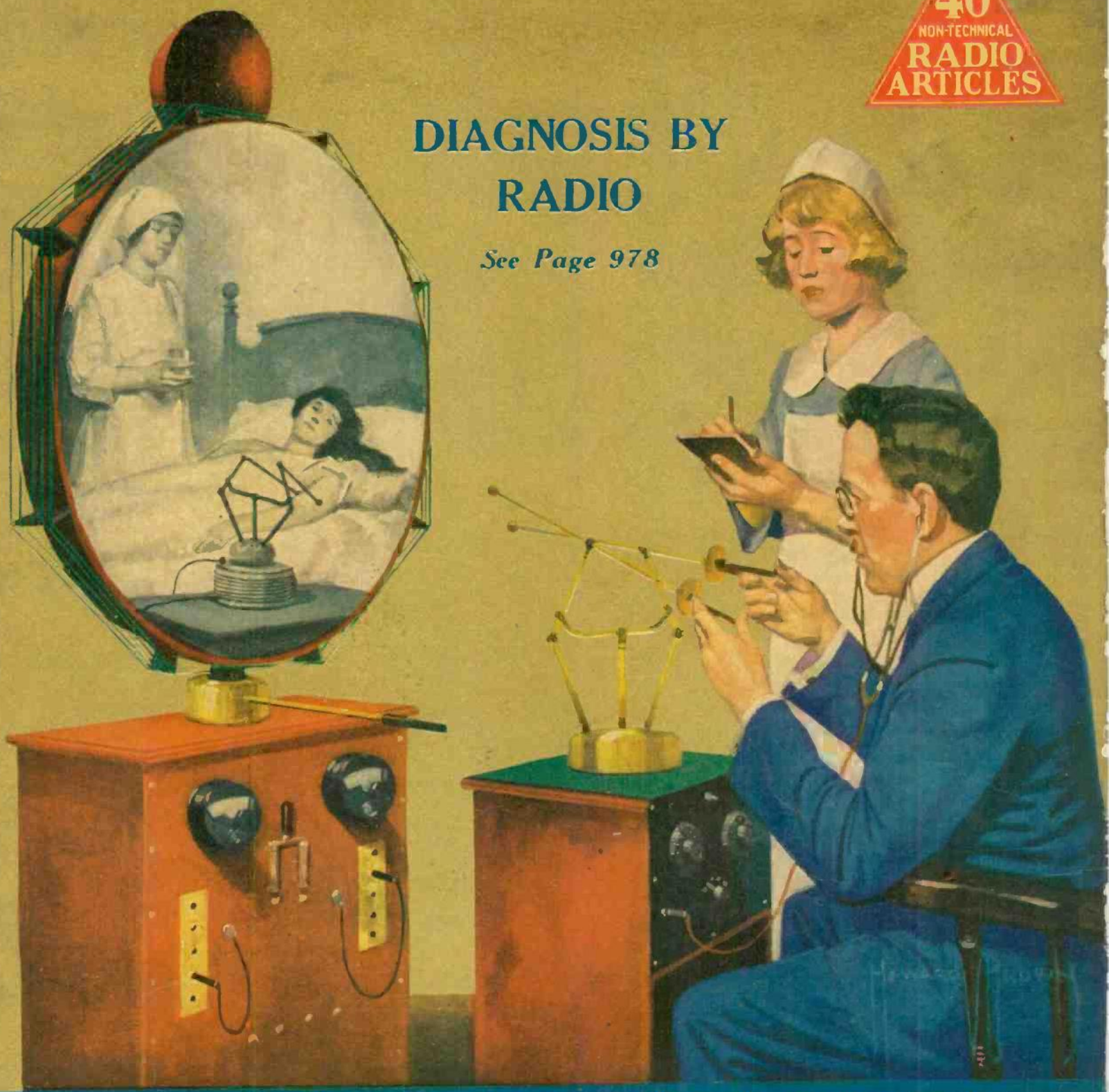
Science and Invention

IN PICTURES

40 NON-TECHNICAL RADIO ARTICLES

DIAGNOSIS BY RADIO

See Page 978



EXPERIMENTER PUBLISHING COMPANY, NEW YORK, PUBLISHERS OF
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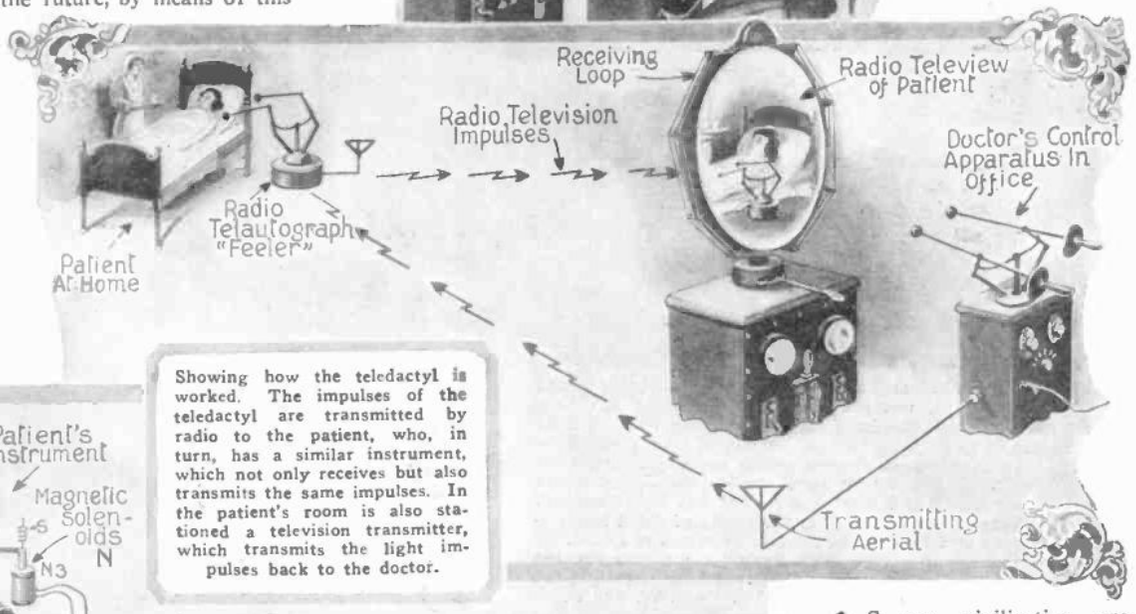
The Radio Teledactyl

By HUGO GERNSBACK
Member American Physical Society

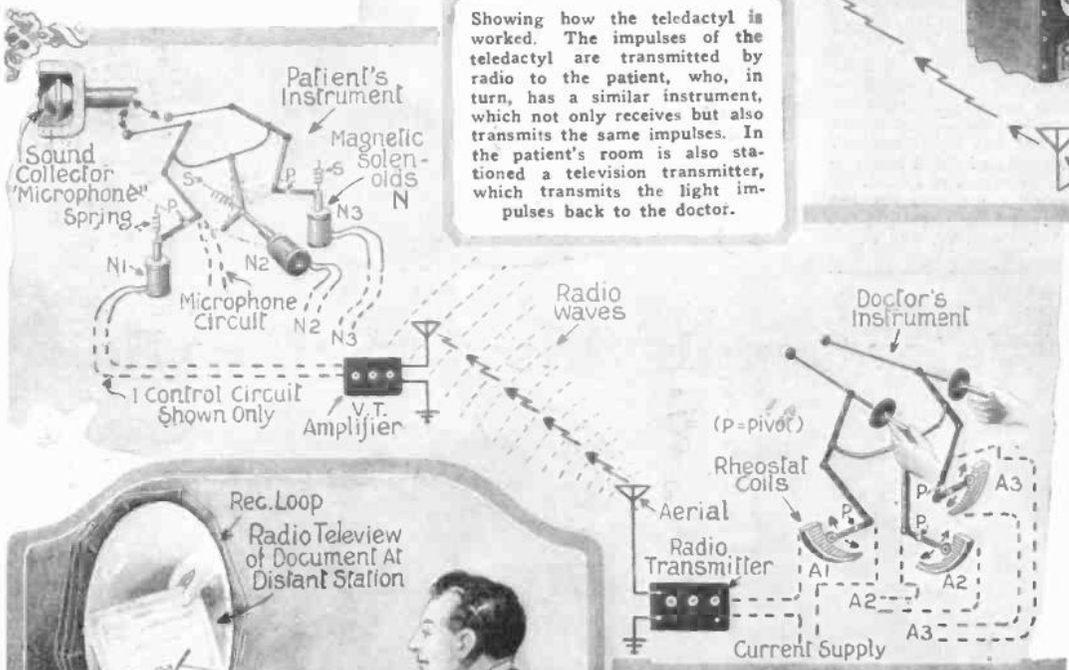
1

The Teledactyl (Tele, far; Dactyl, finger—from the Greek) is a future instrument by which it will be possible for us to "feel at a distance." This idea is not at all impossible, for the instrument can be built today with means available right now. It is simply the well known telautograph, translated into radio terms, with additional refinements. The doctor of the future, by means of this instrument, will be able to feel his patient, as it were, at a distance (see illustration to right). The doctor manipulates his controls, which are then manipulated at the patient's room in exactly the same manner. The doctor sees what is going on in the patient's room by means of a television screen. (See other captions on this page.)

Here we see the doctor of the future at work, feeling the distant patient's arm. Every move that the doctor makes with the controls is duplicated by radio at a distance. Whenever the patient's teledactyl meets with resistance, the doctor's distant controls meet with the same resistance. The distant controls are sensitive to sound and heat, all important to future diagnosis. The doctor sees what he is doing by means of the television screen in front of him.

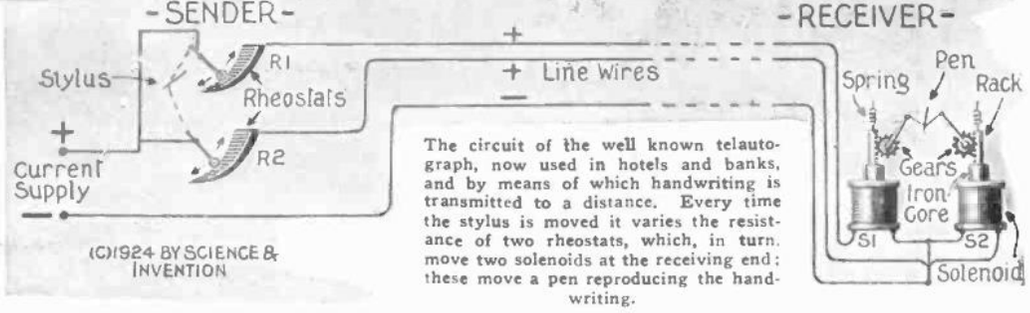


Showing how the teledactyl is worked. The impulses of the teledactyl are transmitted by radio to the patient, who, in turn, has a similar instrument, which not only receives but also transmits the same impulses. In the patient's room is also stationed a television transmitter, which transmits the light impulses back to the doctor.



How the teledactyl operates: The teledactyl is but an improved telautograph; it works, however, in three planes, whereas the present day telautograph works in only two directions. The teledactyl is connected to a radio transmitter, which transmits the impulses; these then are received on the patient's instrument. These same impulses are then transmitted back to the doctor's instrument. The sound collector microphone is used so that the doctor at the other end can use his radio stethoscope and listen to the patient's heart-beats.

Another application of the Teledactyl. Here we see the man of the future signing a check or document at a distance. By moving the control, it goes through exactly the same motions as he would in signing the document. He sees what he is doing by means of the radio televiev in front of him. The bank or other official holds the document in front of a receiving teledactyl, to which is attached a pen or other writing instrument. The document is thus signed.



The circuit of the well known telautograph, now used in hotels and banks, and by means of which handwriting is transmitted to a distance. Every time the stylus is moved it varies the resistance of two rheostats, which, in turn, move two solenoids at the receiving end; these move a pen reproducing the handwriting.

AS our civilization progresses we find it more and more necessary to act at a distance. Instead of visiting our friends, we now telephone them. Instead of going to a concert, we listen to it by radio. Soon, by means of television, we can stay right at home and view a theatrical performance, hearing and seeing it. This, however, is far from sufficient. As we progress, we find our duties are multiplied and we have less and less time to transport our physical bodies in order to transact business, to amuse ourselves, and so on.

The busy doctor, fifty years hence, will not be able to visit his patients as he does now. It takes too much time, and he can only, at best, see a limited number today. Whereas the services of a really big doctor are so important that he should never have to leave his office; on the other hand, his patients cannot always come to him. This is where the teledactyl and diagnosis by radio comes in.

(*Continued on page* 1036)

10,000 Years Hence

By H. GERNSBACK

Member American Physical Society

IF we go back but 100 years, and contemplate how the world looked as, for instance, in the days of Napoleon, we are apt to be amazed at the way in which the world has progressed in a technical sense since then. We believe we need not call attention to the fact that steam, electricity, and up-to-date technic have completely altered not only the face of the globe, but our very lives as well. If such a tremendous change has been possible in a short century, how then will the world appear in a thousand years, or ten thousand years, hence? The imagination fairly staggers at the attempt to picture what our civilization, if it still exists, will look like in the future ages.

The up-to-date scientist has little difficulty in predicting certain things that will happen in ten or fifty years, but ten centuries hence is a large order, even for the most intrepid imagination. That practically nothing of our present civilization will be left after ten thousand years may be safely predicted. We may also prophesy that the human beings, ten centuries hence, will live in entirely altered circumstances from those they now exist in. Captain Lawson, of aerial fame, for instance, not so long ago made the prediction that 10,000 years hence the human race will not live on the surface of the globe at all, but will live far above it. His reasoning is as follows:

He states that at the present time we are living at the bottom of a vast sea—the sea of air—our present atmosphere. We all know that on the surface of the globe this air presses upon every square inch at the rate of 14.7 pounds with a slightly varying pressure. The weight that the human body, for instance, has to sustain is approximately 30,000 pounds, a tremendous figure. We do not come to harm, of course, for the simple reason that the pressure is even in all directions, but our lungs have been accustomed to this pressure and if we suddenly should take this pressure away, our lungs would burst. Even aviators rising only two miles above the surface of the earth have great difficulty in breathing. It is the same with the other great sea, the ocean, which is also but a fluid, just like the atmospheric sea, with the difference that the water is of greater density, otherwise there is little difference, even chemically, between the two seas.

The fish living at great depth (the so-called deep-sea fish) sustain gigantic pressures upon their bodies, and if suddenly brought to the surface, burst like balloons. This is the exact counterpart of the human who wishes to rise to the top of the atmosphere.

Captain Lawson, following his analogy, predicts that centuries hence we will be living at the top of the atmospheric sea instead of at the bottom. In other words, the future human being will not be a deep-sea atmospheric animal, but will reside at the top of the atmosphere, comparatively speaking.

Captain Lawson does not state the advantage of this living miles up, away from the surface of the globe, but we may cite several apparent ones. Most of the human diseases probably are due to bacteria and small micro-organisms floating in our dense air. It may be doubted that such micro-organisms will be found two or three miles above the surface of the earth. Nearly all our diseases, such as tuberculosis, and all other infectious diseases, arise from micro-organisms, which are carried in the dense air, so by making our future abode two miles above the surface of the earth we would at once remove one of the greatest causes of death that humanity has to contend with.

Another change for the better in the upper atmospheric plane is the obvious one, that we will have continuous sunlight. No rain, no clouds, no thunder storms, no snow are to be contended with, once we rise above the highest clouds; and the latter never rise higher than two miles above the earth. More sunlight, as we all know, is most beneficial to human beings, and having 100 per cent of it all of the time we naturally will be far better off.

Just A Few March Articles

Starting the Auto in Cold Weather—Ten effective and practical methods. Fully illustrated and described.

Analyzing Foods Under the Microscope. By Prof. Leon Augustus Hausman, Ph.D.

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Shall I Take Up Engineering?—Part 2. By H. Winfield Secor.

Atoms Made to Order—A Wonderful Scientific Device Which Reproduces Atomic Structures Magnetically. By Joseph H. Kraus.

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Snow Crystals. By Dr. Ernest Bade.

Tiny Ships Probe Body Canals—Discharging medicines and taking samples of secretions. A tremendous advance in the study of medicine.

Another Fine Radio Department. Don't miss it!

It would also seem that the race would be greatly benefited by the rarefied atmosphere as we would be able to move around better, and would not be oppressed by the atmosphere as we are now, particularly on hot days, when the air seems to feel like a thousand tons on our bodies.

These are only a few of the obvious advantages, but there are many more. Thus, for instance, at high altitudes there is no dust to be considered, and dust, as we all know, is highly detrimental to us. We, therefore, may surmise that the human race centuries hence instead of living upon the surface of the globe will live far above it in cities as we have them today, if cities they will then be called.

Our illustration depicts one of the future cities of about the size of New York floating high up in the air, several miles above the earth. The question of sustaining such a large body in a rarefied atmosphere will prove to be of little difficulty to our future electrical engineers. Just as we construct leviathans of the sea today, some of them weighing as much as 50,000 tons, we will construct entire cities weighing billions of tons, which cities will be held in space not by gas balloons, propellers, or the like antiquated machinery, but by means of gravity-annulling devices. Already experiments have been made whereby it has become possible to reduce the weight of substances by electrical forces.

Thus Professor Majorana, in an article printed in this journal three years ago, made it possible to produce negative gravity by reducing the gravitational pull on a lead sphere. Of course, this is but a crude beginning. Centuries hence, when we wish to raise the city of the future high up in the air, we will rely upon an electro-magnetic stream of force which by reaction upon the ether and the earth, lifts the entire city high above the clouds.

Our illustration is but a feeble attempt to show how it may be worked out. Four gigantic generators distributed among equidistant points thru the city shoot earthward electric rays of a nature which as yet we can only imperfectly imagine. These rays, which are not light rays by any means, but are tremendous lines of force, impinge upon the surrounding ether with such stress and speed that the entire city is lifted up to the height desired. These rays may be likened to water streams, which by reaction would hold up the city illustrated. In other words, if we imagine the four rays as shown to be substituted by tremendous jets of water pouring earthward, and provided these jets were continuous, we can easily understand that they would support the entire city by counter-action of the force of inertia of water pressing against the lower part of the city.

By increasing or decreasing the electrical energy of this future floating city it can be lowered or raised as we desire. By directing the rays sideways we will go in the opposite direction. Thus the "captain" of the future city will have a means to steer the city with all its millions of inhabitants to any part of the globe.

Where does this tremendous conglomerate take its energy from? The sun, of course. The city of the future is not dependent at all upon the earth for its power. Solar energy, which is merely another form of electrical energy, will be converted into electricity and stored away covering all the needs of the vast machinery, and that of the populace as well. Also, we should not forget that atmospheric electricity is a power that we only dimly understand today. This power in the future will be turned to the use of mankind, and we will then tap a practically unlimited amount of electrical energy.

As our illustration shows, the city of the future will be entirely roofed over with a substance that is neither glass nor metal. It will be transparent, but as strong as metal and unbreakable. Over this dome-like structure, gigantic towers are placed, which suck in the static electrical energy as well as the solar energy. Within the covered city the atmospheric

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The City of the Future, 10,000 Years Hence, Will Not Be Located Upon the Surface of the Earth. It Will Be Floating Up Miles High, and Such Things as Snow, Rain, and Storms Will Be Unknown to the City Dwellers of the Future. It Will Have Perpetual Sunlight, and Weather Will Never Bother Our Future Citizens. Just as Our Leviathans of the Sea are Built to Remain on the Top of the Water at All Times, So the Floating City of the Future Will Remain Afloat Continuously, Supported Only By Shafts of Electro-Magnetic Rays, Which, Nullifying Gravity Keep the City Raised Up By Reaction. The City Dweller of the Future Will Not Be Bothered Much With Such Diseases as Tuberculosis, Because All of These are Now Transmitted Due to the High Density of the Air Near the Surface of the Earth. Three or Four Miles Further Up Bacteria are Not So Common as Near the Surface of the Earth.

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View of Downtown Section of New York City, with the Woolworth Building and City Hall in the Foreground, as It Would Appear if a 250-Mile Gale Suddenly Swooped Down Upon the Great Business and Financial Section of the Metropolis. Those Structures Having High Towers, Such as the Woolworth and Singer Buildings, Would Suffer the Most from Such a Storm; the Towers Would be Blown Over and Smash Other Buildings in Their Path. All of the Streets Would be Showered with Stone and Concrete Blocks, and It Is Doubtful if a Single Soul Would Escape. New York's Skyscrapers Are Designed to Stand a 100-Mile Gale, but Such a Storm as That Described by Mr. Corrigan Would Present a Condition Such as Here Pictured.

If a 250-Mile Gale Struck New York

By C. S. CORRIGAN, C. E.

IT is said that an ordinary wind on the moon blows 250 miles per hour. Suppose such a gale struck New York City; what would it do to the Woolworth building towering 785 feet in the air? Oh! you say, we never had a storm that blew a hundred miles an hour, so it would be impossible to have a 250-mile gale; but airmen know that such gales, called aerial trade-winds, come within six miles of New York City every day, if we measure straight up, and that twelve miles up the wind blows 500 miles an hour all the time, at least Rickenbacker and other flying aces say so, and are even figuring on using these trade-winds to circle the earth by airplane in fifty hours or less.

Now suppose, that just to retaliate, one of these two-hundred-and-fifty-mile-an-hour aerial trade-winds should take a notion to drop down six miles to New York without slackening speed, it would only take a minute and a half to get here, then what? You assume a wise expression and say, "Oh, nothing, that air is only one-third as heavy as surface air, so it wouldn't push any harder than an ordinary 83-mile gale, say thirty pounds per square foot, and as the Woolworth building was built to stand a 100-mile gale, fifty pounds per square foot, it wouldn't be damaged at all."

But, hold on a minute, you just said that aerial air was only one-third as heavy as surface air, so, of course, it only presses five pounds per square inch in every direction, or one-third of the fifteen pounds per square inch that surface air presses in every direction. Then remember, it came so quick that the particles of surface air inside the building had no chance to get in line and march out, so, like people in a theater that catches fire, they all crowd and push fifteen pounds per square inch outward, while the aerial air only presses inward at five pounds per square inch; this makes a difference of ten pounds per square inch or 1,440 pounds per square foot outward pressure in all directions, including straight up. Figured for a wall 10x16 feet this would be equal to 160 Samsons pressing outward with all their might, 1,440 pounds apiece, 230,400 pounds in all. There are a thousand such walls in the Woolworth building so the temple cannot help but fall.

Suppose we deduct the thirty pounds per square foot on the side the wind is blowing against, we still have an outward pressure of 1,410 pounds per square foot, which is thirty times as much as the walls were built to stand, so the brick and terra cotta and doors and windows would all fly out into the face of the storm almost as hard as in any other direction, the tower and roof would fly up and the air cushion provided at the bottom of all elevator shafts, instead of gently stopping the elevators that were going down, would expand so suddenly that it would shoot the elevators full of people right out of the top of the shafts. Even the steel safes would blow open as if all the money had turned into T. N. T. Not only the Woolworth building but the whole city would be instantly and completely destroyed; still you think you told the truth at first, it wasn't the wind that did the damage, but the little two-thirds vacuum which the wind dropt in its flight.

Now coming back to that 250-mile wind on the moon, where there is only 1/500th as much air pressure as in the storm I have just described, I'll say the wind wouldn't hurt you any more than a storm of light waves that shoot from behind a cloud and hit you at the rate of 186,000 miles per second. But I can't begin to guess what that perfect little imp of an almost perfect vacuum will do when dropt in the vicinity of the Woolworth building. I think I'll pass that up to the pretty little spark dropt by the pretty little cigarette in a powder house.

The worst storm ever recorded at the weather bureau in New York blew at the rate of 96 miles per hour, and the lowest reading of the barometer was 28.68, less than one pound below the normal 15 pound pressure; the worst part of the

(*Continued on page* 948)

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An Interview With Nikola Tesla

By H. WINFIELD SECOR

AT the present day when many momentous problems in science and international politics are being weighed in the balance of logic and reason, it is a very opportune time, it seems, to listen to the views and ideas entertained on some of these problems by such a famous engineer and scientist as Dr. Nikola Tesla. The interviewer wended his way across Bryant Park in the shadow of the great Astor Library and ascended to the 20th floor of an adjoining skyscraper, where Dr. Tesla has his offices and laboratory. Having made known my mission, I asked Dr. Tesla the following questions.

The Disarmament Conference

Q. Do you believe that the Disarmament Conference now being held at Washington will do much good, especially with respect to prevention of war?

A. The extraordinary proposal of Secretary Hughes has produced a favorable impression thruout the world and the remarkable readiness with which it was taken up by the foreign governments is an auspicious beginning. Some agreements as to naval expenditures and status of the Powers in the Pacific have already materialized and that other results of value will follow there can be no doubt. But it is equally evident that they will consist merely of economic measures, which can have only a negligible influence as preventatives of war.

The primary object of the Conference is the reduction of armaments. As the safety of any country depends not on the absolute, but relative, military strength a proportionate reduction of the force and equipment suggests itself naturally as a means of lessening the cost of upkeep. This is a very old idea in the practical application of which insuperable difficulties have been encountered heretofore for want of proper standard of reference. The requirements are different in each individual case and an attempt to make the reduction on the basis of population, area, resources, industry, commerce, or any other national asset, would be manifestly futile. Moreover, participation by every nation is essential to the thoro execution of such a plan, and to arrive at an adjustment satisfactory to all would be next to impossible. All that can be accomplished at present is some equitable treaty between the few leading countries for minimizing the burdens of war, which is highly desirable for economic reasons but leaves the main problem unsolved. The idea that armed conflicts between nations can be prevented by written covenants involves a scientific fallacy. It is an attempt to put effect before the cause. Experience must precede the formulation of laws. Universal peace may be eventually brought about by civilizing forces and agents and international conferences will then only serve the purpose of giving clearer expression to a common desire. Nevertheless, the conclusions reached at Washington may prove of tremendous consequence in time to come, especially for this country which, until lately, has adhered to its traditional policy of isolation.

On general principles three courses are open to the United States. One is to continue arming and maintain an overwhelming superiority over other nations. The inexhaustible wealth of this country would easily enable it to keep up the pace and if safety is placed above every other consideration this should be done. The carrying out of the program would call for vast outlays but under the conditions existing American military supremacy might, perhaps, be the best means of insuring general prosperity and welfare. The second is to advocate complete disarmament insofar as the enforcement of law and order would permit. In that case this country would still be safe, as its resources would enable it to prepare for war quicker than any foe. The third is to enter an agreement with other powers, limiting the armaments, which would virtually mean an alliance involving more or less hazard and peril.

As regards the abolishment of war, the measures adopted by the Conference to this end will be as futile as all the previous ones. Opinions on this subject are divided. In the view of some, war is the greatest curse; others think it is a psychological necessity and beneficial—like a storm which clears the atmosphere. There is a perpetual conflict going on between nations as well as individuals. Ordinarily it is merely a competitive struggle, occasionally it becomes a deadly strife. This is primarily due to imperfect mutual understanding and the basic physical cause is the immense extent of the terrestrial globe. The most effective means towards insuring universal harmony and peace is, accordingly the annihilation of distance which must be brought about in three distinct respects: (1) dissemination of intelligence; (2) transmission of energy, and (3) transport of bodies and materials. All this can be done thru the development of the wireless art. As the first step I proposed twenty years ago my World-System which would leave all the present means intact and enable instantaneous transmission from one to any other point of the globe, of signals, speech, pictures and characters of every description. I have made important improvements since and am almost assured that a number of comparatively very small and compact plants, with a telephonic range of twelve thousand miles and devoid of high towers, will be put in operation in various countries. Of immeasurably greater consequence, however, will be the wireless transmission of energy, which can be successfully effected by the use of the same underlying principles and will make cheap motive power for all purposes available everywhere. Then it will be possible to propel flying machines at great speed without fuel and thus space will be annihilated and the impediments to contact and mutual understanding removed.

NIKOLA TESLA has no doubt one of the greatest intellects of his time. Our readers will be pleased to peruse his latest ideas concerning world matters of interest to all of us. We have stated in our columns before that Dr. Tesla is at least 100 years ahead of our times. Many of his prophecies have come true in the past, and we believe that the words which he addresses to the world thru SCIENCE AND INVENTION will be listened to attentively by all.
—EDITOR.

Future Wars

Q. What are your views on science in respect to future wars?

A. Discovery and invention ever tend to intensify the forces and agents for attack and defense. The wars of the future will have no semblance to those waged up to now. They will cause less physical suffering but will be all the more terrible. The countries engaged in the conflict will not send out armies, fleets, or aerial squadrons to meet in battle, but crewless vessels will be launched from one to the other with enormous speed and at distances of thousands of miles. Such apparatus does not exist but could be speedily constructed and in an article on "Telautomatics" which appeared in the ELECTRICAL EXPERIMENTER (former name of SCIENCE AND INVENTION) of October, 1919, I have endeavored to convey an idea of the same. These infernal engines will drop quantities of poisonous gases and other destructive chemicals on any city or place, the geographical position of which is accurately known. Battleships, guns, torpedoes, submarines and even manned flying machines will become of trifling importance and there will be no need for admirals, generals, or commanders of forces, as all the work will be done by electricians, engineers and mechanics.

International agreements will not stop war, for the simple reason that they will be ignored the moment the life of the nation is at stake. To preserve itself it will sacrifice everything else. That is why Germany violated the neutrality of Belgium and why Italy deserted her allies. Before universal peace can be attained the whole human race must be changed for the better, thru closer contact and cultivation of a higher ideal, which will gradually supplant that of patriotism.

Is There Vegetation and Life on the Moon?

Q. Do you believe that there is vegetation and life on the moon, which we have always been taught possesses no atmosphere capable of supporting such?

A. I have read with great interest the announcements of Professor Pickering, as well as some adverse comments on the same. Personally I am inclined to place greater faith in the statements of a painstaking specialist than in the opinions of those who have not studied the subject, however competent they might be otherwise. The observations of this astronomer, if confirmed, will be of great importance, not only to science, but because of the psychological effect on human beings. I have always thought that any evidences of life on other planets would be of incalculable benefit to our world, and this is why I have devoted much of my energies to interplanetary communication ever since I received, in 1899, the singular disturbances that, according to all experimental evidence, emanated from Mars.

Future of Electrical Engineers

Q. What are the chances today and in the immediate future for electrical and radio engineers?

A. As regards the application of electricity, although the development of late

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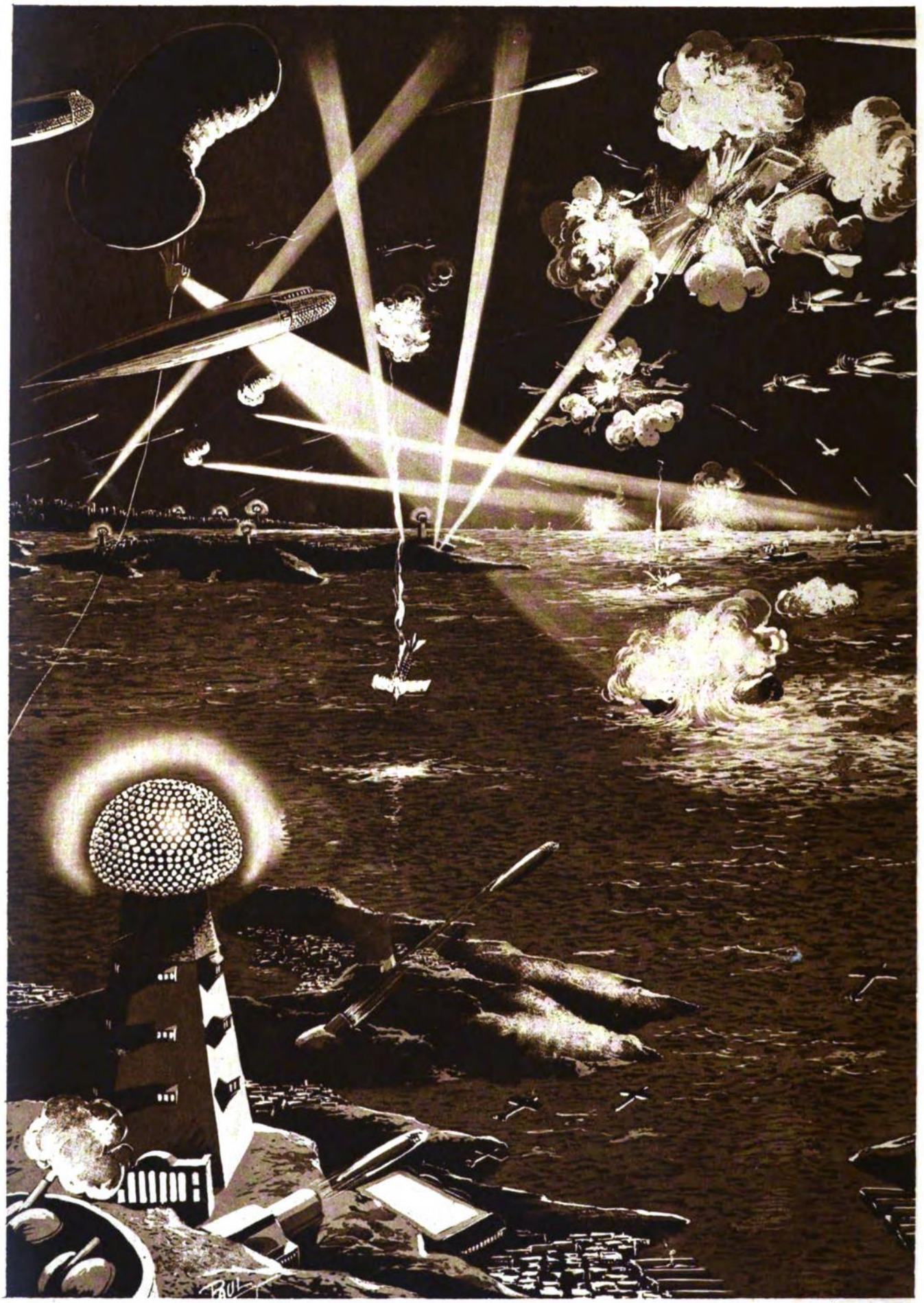

War of the Future as It Will Be Conducted From the Viewpoint of Dr. Tesla. Machines of Destruction More Terrible Than Anything Concocted By the Master Minds Behind the "World War" Armies and Navies, Will Sail Under the Ocean and Thru the Skies—With Not a Man On Board. According to Dr. Tesla These Death-Dealing Monsters of the Sea and Air Will Be Controlled and Directed From Distant Points Hundreds or Even Thousands of Miles Away By Radio Waves of the Proper Sequence and Frequency. The Tower-like Structures Seen On the Land in the Accompanying Picture are Transmitting Radio-Electric Power for Operating and Controlling the Sea and Air Defense Craft. When One of These Aerial Machines Passes Over an Enemy City, the Proper Radio Control Wave Is Flasht Out and the Giant Craft Drops Gas and Explosive Bombs, Destroying Buildings and People as Well. Man Will Be the Master Mind Behind the Future War, But Machines Only Will Meet in Mortal Combat. It Will Be a Veritable War of "Science."

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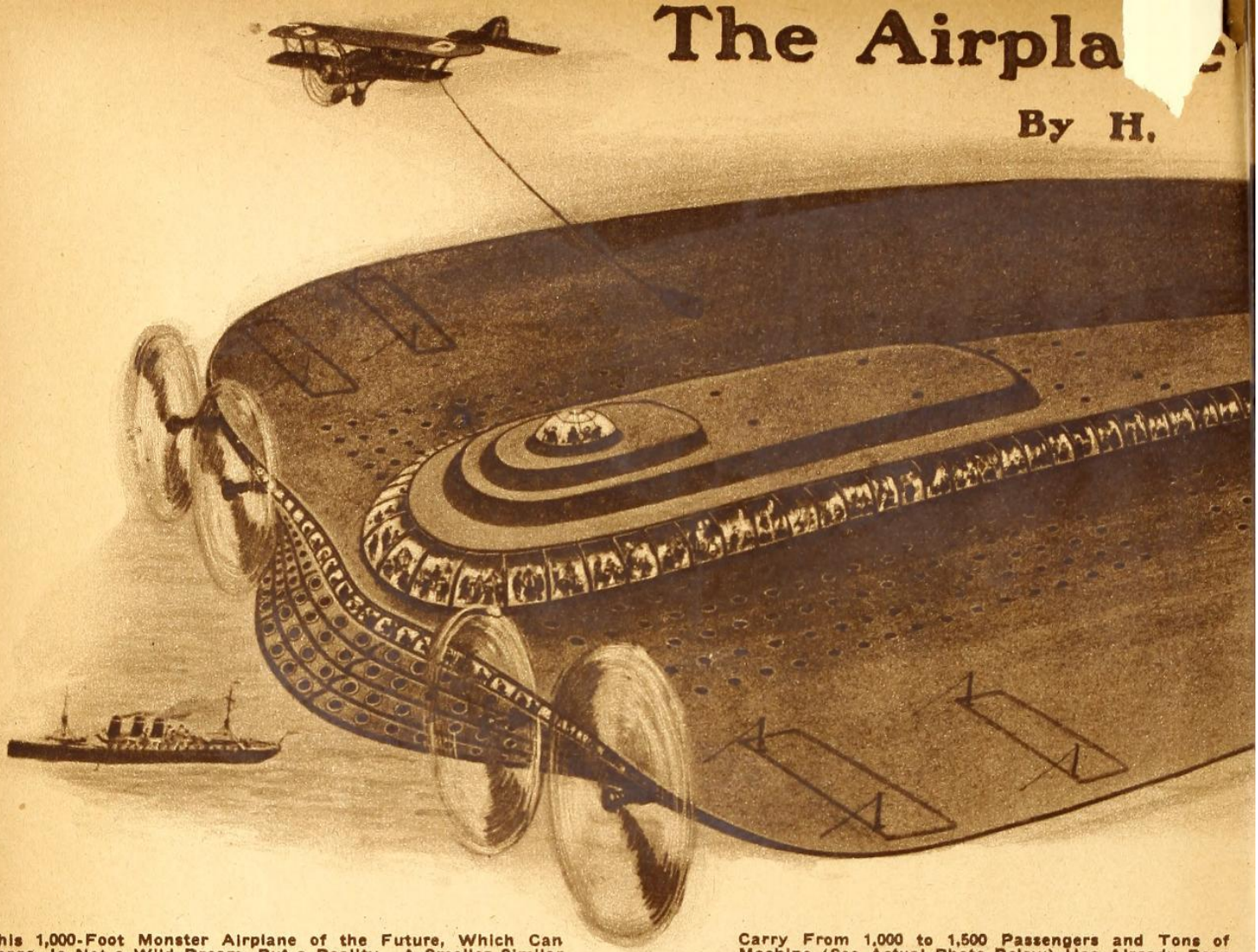
The Airpla[illegible]

By H.



This 1,000-Foot Monster Airplane of the Future, Which Can Carry From 1,000 to 1,500 Passengers and Tons of Cargo, Is Not a Wild Dream, But a Reality. A Smaller Similar Machine (See Actual Photo Below) Has Already Been Built by Mr. Wm. B. Stout. This Future "Batwing" Will Fly at the Tremendous Speed of 500 Miles an Hour. In Other Words, the Trip From New York to London Will Take But Six Hours!

WE are about to witness a great revolution in airplane construction in the very near future. The present airplane as far as its construction is concerned has about reached its limit for a number of reasons. One of the most important reasons is that the extra bracing and struts required to give strength to the present day giant airplane retards its speed due to the greatly added air resistance. The other chief reason is the limited passenger and cargo space available even in our huge, present day machines. Every pound of cargo that we add increases the spread of the wings and again makes it necessary to use more and larger struts, which in turn decreases the speed of the machine.

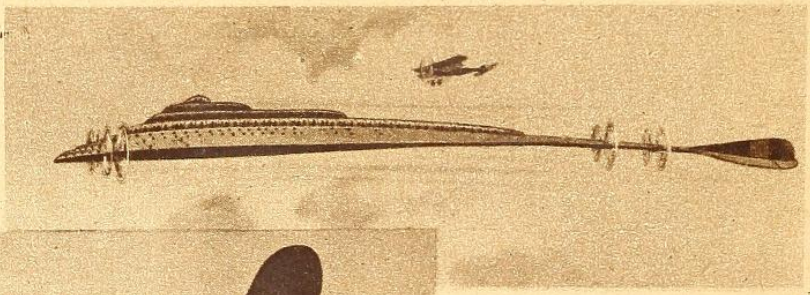
During the war William B. Stout, an American aeronautical engineer, formerly with the Air-Craft force in Washington, produced a wonderful new airplane, a photograph of which appears on this page. He was assisted by Orville Wright, the inventor of the airplane, as well as the U. S. Government. The machine is known as the *hollow wing type*, and it is claimed that this machine anticipates the German machine of the same type recently put into use in the United States. Mr. Stout built his original machine at Dayton, Ohio, during the war and the first flight of the new airplane was made in the year 1918.

The plans had been kept secret and more than 1,000 men located in different cities made the various parts of the machine inasmuch as the Government wished to keep the design secret. However, photographs and blueprints were stolen during the war and thus found their way into German hands, thus giving them the idea for their airplane.

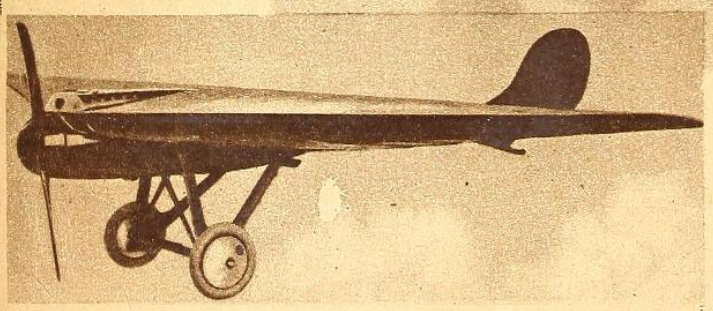
The revolutionary feature of the Stout "Batwing" is nothing but a giant double wing with all the machinery, trussing, etc., housed right inside of the hollow wings. The engines are placed in the front edge, while the passengers and cargo are enclosed between the wing surfaces. The important point is that every part of the machine exposed to the air is designed with the sole idea to LIFT.

Altho the new airplane has 480 square feet of wing surface, or 40 square feet more than an army two-seater, it only weighs half as much as the latter. In other words, 1,550 pounds as against the 3,220 pounds of the army machine!

The "Batwing" has been tested in a wind tunnel for a speed of 217 miles an hour, and it is claimed that it can rise easily to 32,000 feet. It can climb a mile in 2½ minutes and all this is accomplisht with a little 180 horsepower motor. An unexpected result of the new construction is that inasmuch as the radiators are housed inside of



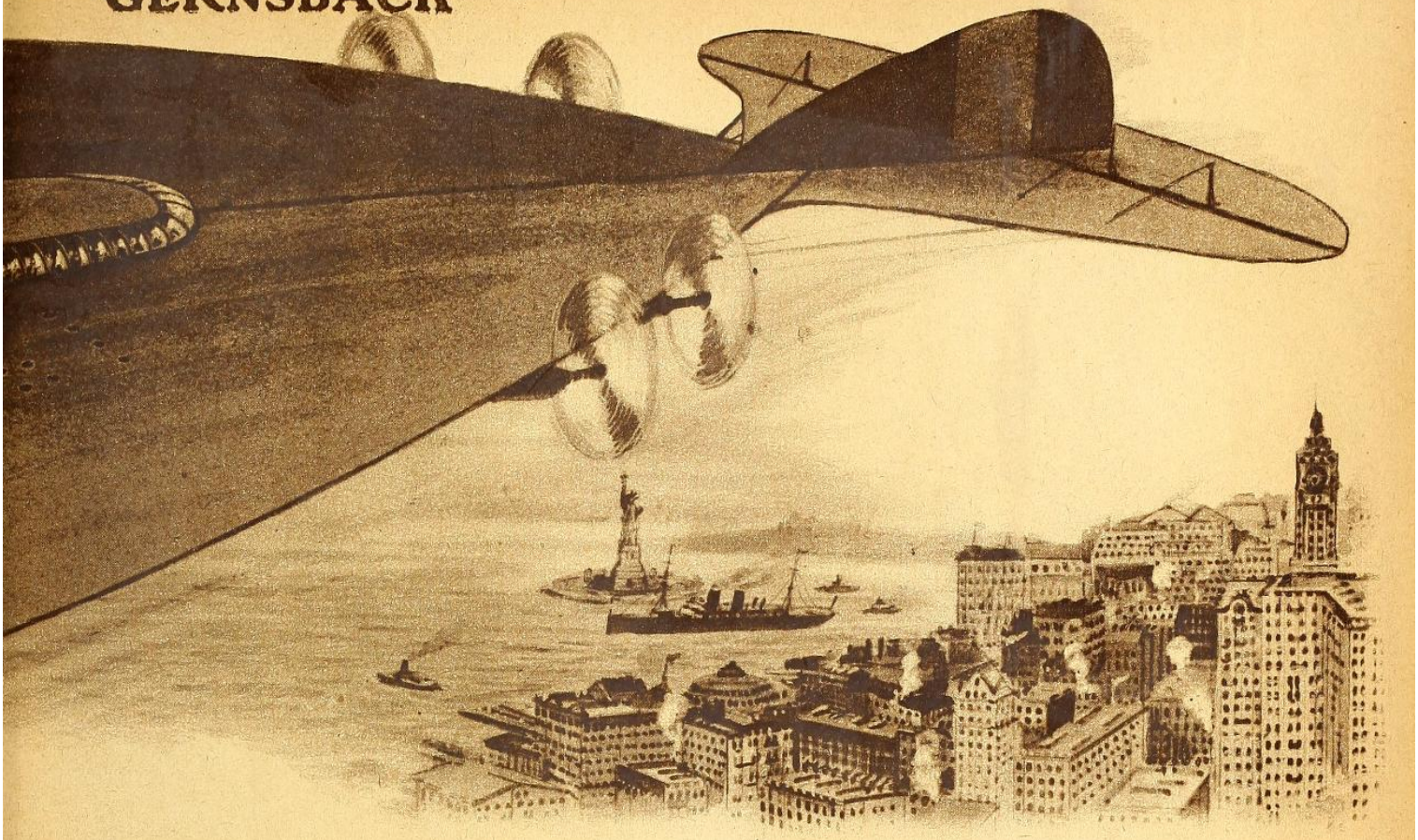
Below: Actual Photo of the Hollow-Wing "Batwing" Airplane Invented by Wm. B. Stout, Who Was Assisted by Orville Wright and the U. S. Government. The Machine Was Built in 1918.



Above: A Side View of the Airplane of the Future. The Lower Surfaces of the Wing Are Curved Downwards to Obtain a Better Purchase on the Air. Note That Such a Machine Has no Struts or Wires. Everything Is Inside of the Metallic Envelope.

of the Future

GERNSBACK



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Eight 100-Foot Monster Propellers Drive the Huge Air Liner, Which Is Entirely Enclosed Within a Metallic Envelope Made of Magnesium, a Metal Thirty Per Cent Lighter Than Aluminum. Altho This Airplane Does Not "Look Safe," Experiments Have Shown That It Is SAFER Than the Present Type Airplane. Due to Its Huge Surface, Such a Machine Acts Like a Parachute, and Actually Prevents the Air Monster From Making a Too Rapid Descent.

the wings, the passengers and pilot are easily kept warm when the machine rises to high altitudes.

Another novel idea presents itself in the larger types, where the landing gear is made to pull into the wing so as to give less air resistance. So much for the machine that has been actually built and is in existence. We now get a good conception of what the huge aerial liner of tomorrow will look like. We have tried to show in our large illustration just how such a new aerial monster will appear in ten or fifteen years from now. All of our preconceived ideas as to what an airplane should look like are swept away by Mr. Stout's revolutionary invention.

The important and outstanding fact as well as the revolutionary possibilities which made the "Batwing" possible are best explained in the following:

The lifting power of an airplane wing depends solely on its curve and it is not affected by its thickness. You will have to ponder awhile over this seemingly impossible statement, which is not a theory by any means but has been brought out by actual tests of Mr. Stout's "Batwing." In other words, this means that the future airplane will be constructed, not like a frail kite-like machine, such as our present day airplanes, but rather like an ocean greyhound built on sound engineering principles. Once our struts and braces are enclosed between two parallel surfaces nearly all our wind resistance vanishes and the plane can be pusht ahead at a very much smaller expenditure of power. Not only this, but the size of the future airplane is no longer of consequence as long as we have sufficient power to propel the airplane. Furthermore, if we provide sufficiently large landing fields or air ports, the airplane of the future can be built in unbelievably large proportions. A thousand-footer will be nothing to wonder at tomorrow and will be as common as the 200-foot steamship is today.

We have tried to show in our large illustration how such a thousand-foot monster appears winging its way homeward from its European trip. A machine of this kind driven by a great many propellers easily averages 500 miles an hour and for that reason can make the trip from Europe readily in six or seven hours. In other words, a man can transact business in New

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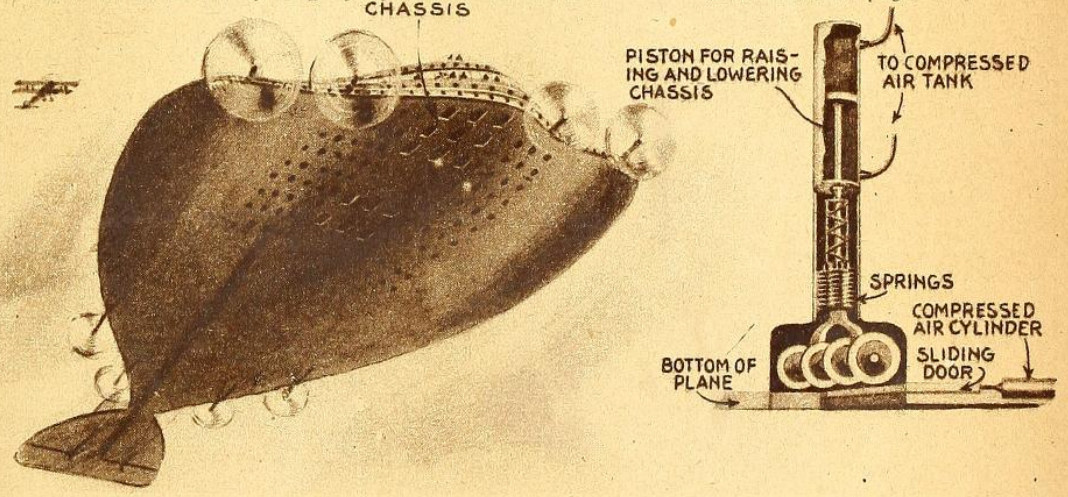

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Bottom View of the Machine. Note Particularly the Chassis or Landing Gears Withdrawn Within the Machine—Just Like a Bird Draws Its Feet Close to the Body to Cut Down Air Resistance. The Landing Skids, Too, Withdraw, But Are Pusht Outward Just Before Landing. The Circular Holes in the Lower Surface of the Machine Are Glass-Covered Portholes. Insert Shows How Chassis Is Lowered by Means of Compress Air.

A "Propeller-less" Airplane

By H. WINFIELD SECOR

SINCE the invention of the first airplane, practically every inventor who has evolved new principles for the propulsion thru the air, of a heavier-than-air type of machine, has invariably advocated the employment of some form of air screw or propeller. Every airplane today, used in the armies and navies of the world, uses a propeller rotated at high speed by powerful engines, developing several hundred horsepower.

Wherefore and hence we have with us at present the very latest idea in airplanes, not only for small machines, but for large ones which may eventually be used for transatlantic and transcontinental air travel —*the propeller-less airplane!* One of the main features of the new blower-type airplane, here shown and designed by one J. W. Webb, of Chicago, is the fact that the machine can be elevated vertically from a given spot and does not require an elaborate landing and starting ground of considerable size as at present.

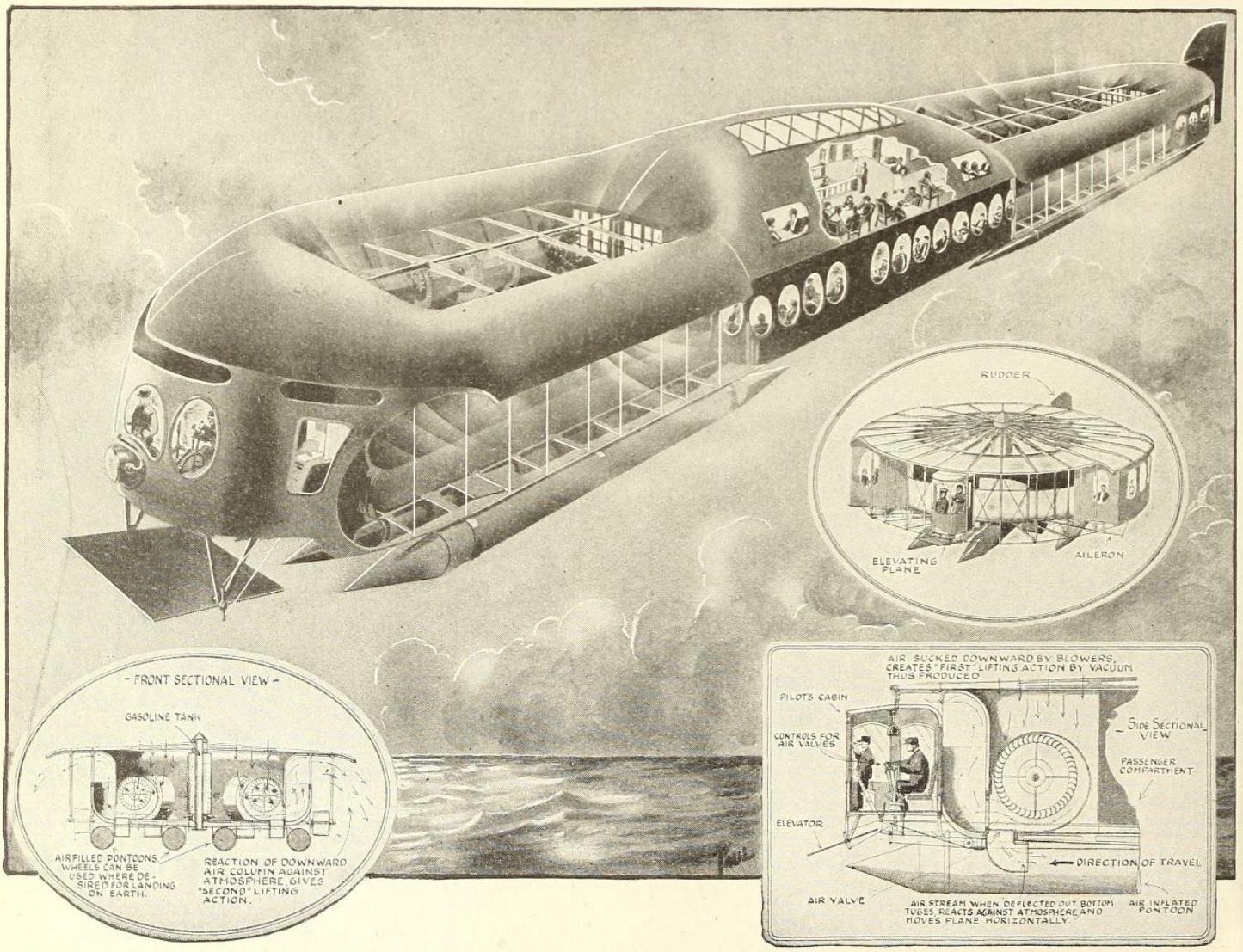
Among the other features claimed for this machine (which employs the resulting effects due to sucking downward a powerful draft of air thru the openings in the top of the machine, and blowing the air out by means of powerful engine-driven blowers from under the wings) are the following: That the machine will be able to sustain a considerable load and ascend vertically to any desired height; maneuver laterally at any desired angle with or against the wind; and, moreover, it is capable of hovering in a stationary or fixt position in any desired point, ascending or descending as may be necessary to avoid air currents or to take advantage of them.

Such a stationary flying craft would be of untold advantage in military maneuvers when used as a wireless station for directing artillery fire, and for numerous other purposes in both peace and wartime.

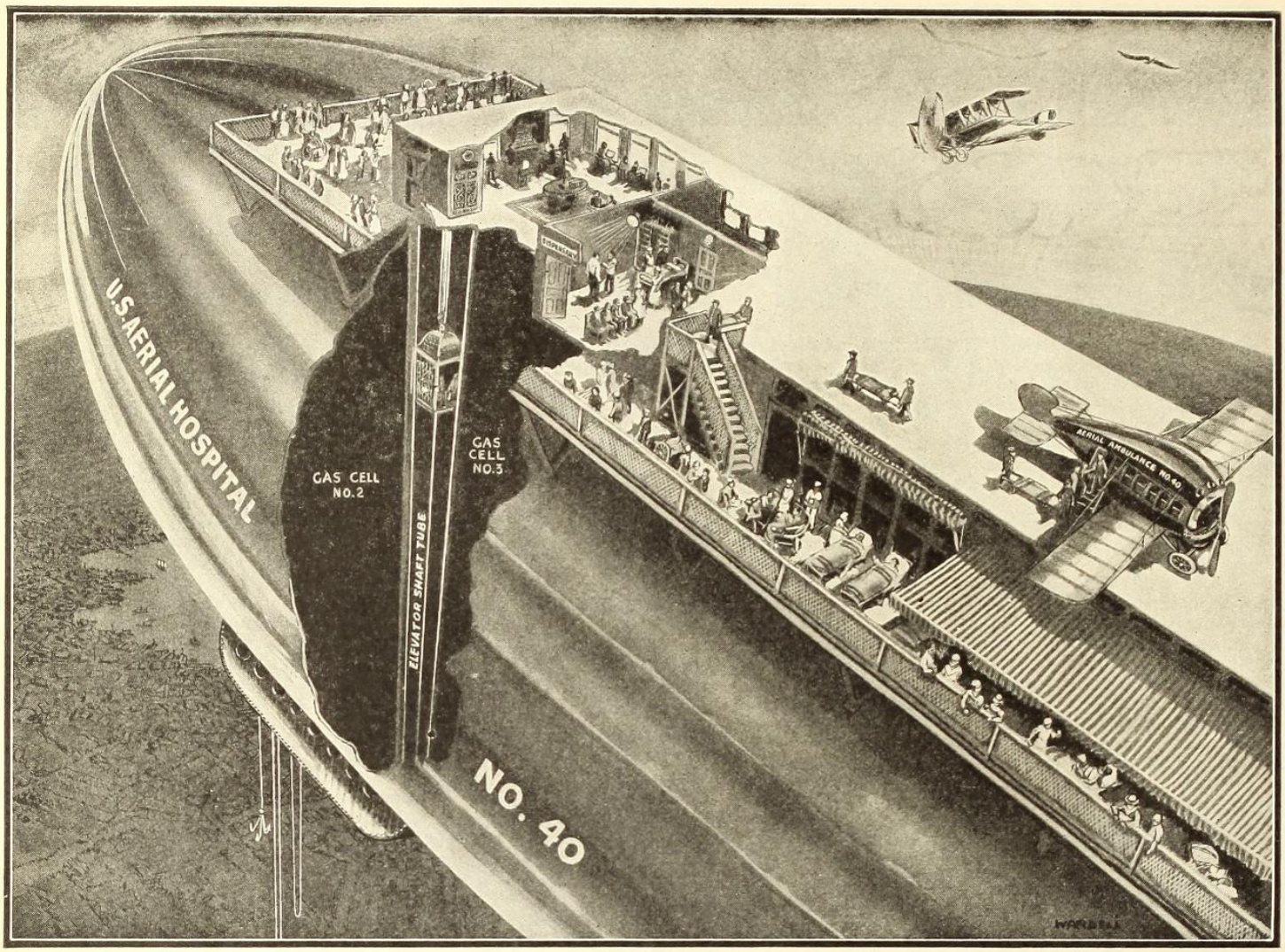
The inventor of this new propeller-less airplane makes use of several aircraft engines such as the *Liberty*, or other type of gasoline motor, which are directly connected to a series of powerful air *blowers*, enclosed in the usual steel housings, these fans sucking the air downward thru the top of the plane and whirling it around until it attains a high velocity, and then shooting it out thru the funnels, as shown by the arrows in the drawings. The reaction of these multiple blasts of air against the atmosphere causes the plane to rise.

The plane is also caused to rise due to the partial vacuum produced above it when the blowers are started, owing to the powerful suction present. The airplane is directed or steered in any desired direction by deflecting a certain number of blower air streams by means of suitable dampers or valves down thru a series of curved nozzles placed under the floor of the machine. The powerful drafts of air shot out horizontally thru these nozzles react on the atmosphere, causing the plane to move in the opposite direction, as the arrows clearly show. Suitable elevating and rudder planes are provided fore and aft also to help navigate the craft.

This airplane may be fitted with collapsible wheels for use when descending upon land also with pontoons for landing on water. The inventor provides a clever system of inflatable pontoons which are quickly filled with air from a motor-driven air blower. These may be covered with rubber cloth or *doped* airplane fabric and not only may serve as soft cushions in landing the machine, or pontoons for water descents, but also serve as *keels* which assist in maintaining the machine in a true course while flying. The air dampers or valves as well as the elevating and starting rudders are all controlled from the pilot's cabin at the front of the machine. For a circular airplane of this type, 32 feet in diameter, the inventor proposes to use a 400 H.P. engine, driving eight fans or blowers with a capacity sufficient to draw a total of 280,000 cubic feet of air per minute at a velocity of 55 miles per hour.



"Propeller-less" Airplane Devised by Chicago Inventor Which Employs the Usual Engines But Instead of Driving Propellers, They Serve to Rotate High Speed Blowers Which Develop Powerful Drafts of Air. These Rapidly Moving Air Currents Are Deflected Out and Downward from Under the Wing Surface, for Vertical Ascension—and Horizontally, Thru Curved Nozzles, for Lateral Propulsion in Any Direction. The Vacuum Produced at the Top of the Machine Aids in Ascending Vertically from a Given Point.



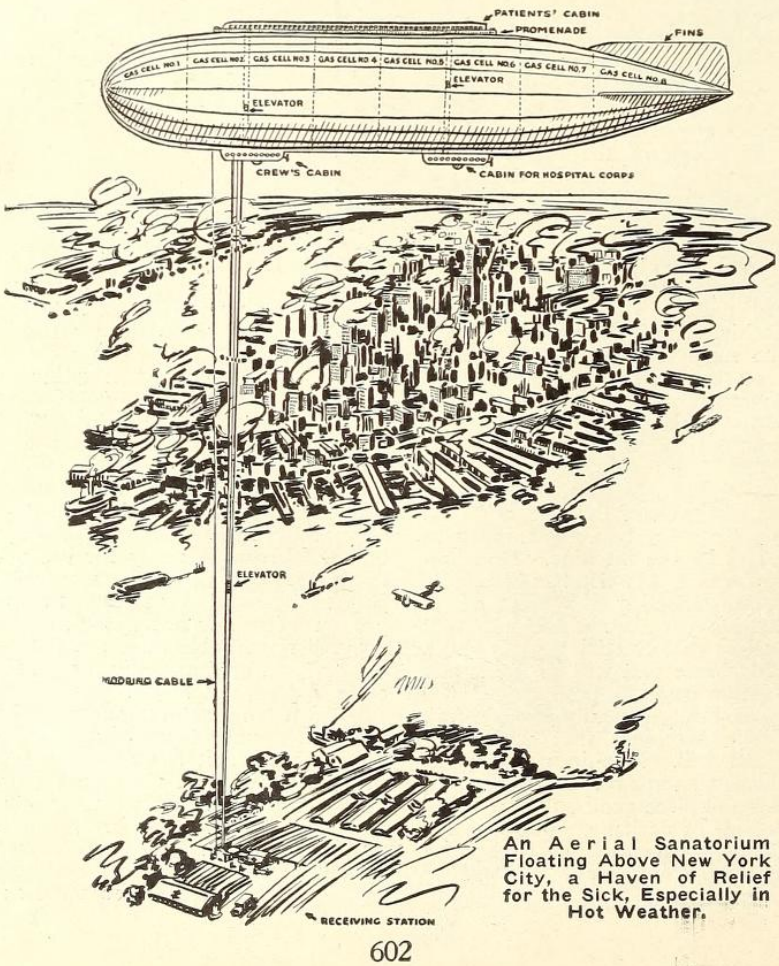
An Aerial Sanatorium

By F. E. LOUDY, AE. E.

TWO things are essential in this world-wide battle against the white plague, sunshine and fresh air. Usually this means a costly trip to Colorado or some other high and dry territory. Instead of transporting tuberculosis patients to the sanatorium we should bring the sanatorium to the patients. This can be done by using giant captive balloons, structurally similar to the great Zeppelins, which can be moored near the large centers of population, like New York and Chicago, where this disease is more prevalent.

These giant airships would be composed of a rigid yet light duralumin structure, containing eight independent helium gas cells. Helium is an inert gas, non-inflammable and while lifting less than hydrogen is quite light enough for good efficiency.

The patients' cabin is located on top of the airship so as to get as much sunshine as possible, while the airship crew occupies the lower forward cabin, and the hospital corps occupies the lower rear cabin. Since this airship is 800 feet long and 100 feet in diameter, it becomes necessary to travel from cabin to cabin by means of an elevator operated by an electric hoist, as shown in the illustration.



An Aerial Sanatorium Floating Above New York City, a Haven of Relief for the Sick, Especially in Hot Weather.

The patients' cabin contains the sleeping quarters, dining-room, galley, library, dispensary, a piano and moving picture outfit. Everything possible is supplied to permit the patients to forget their ills.

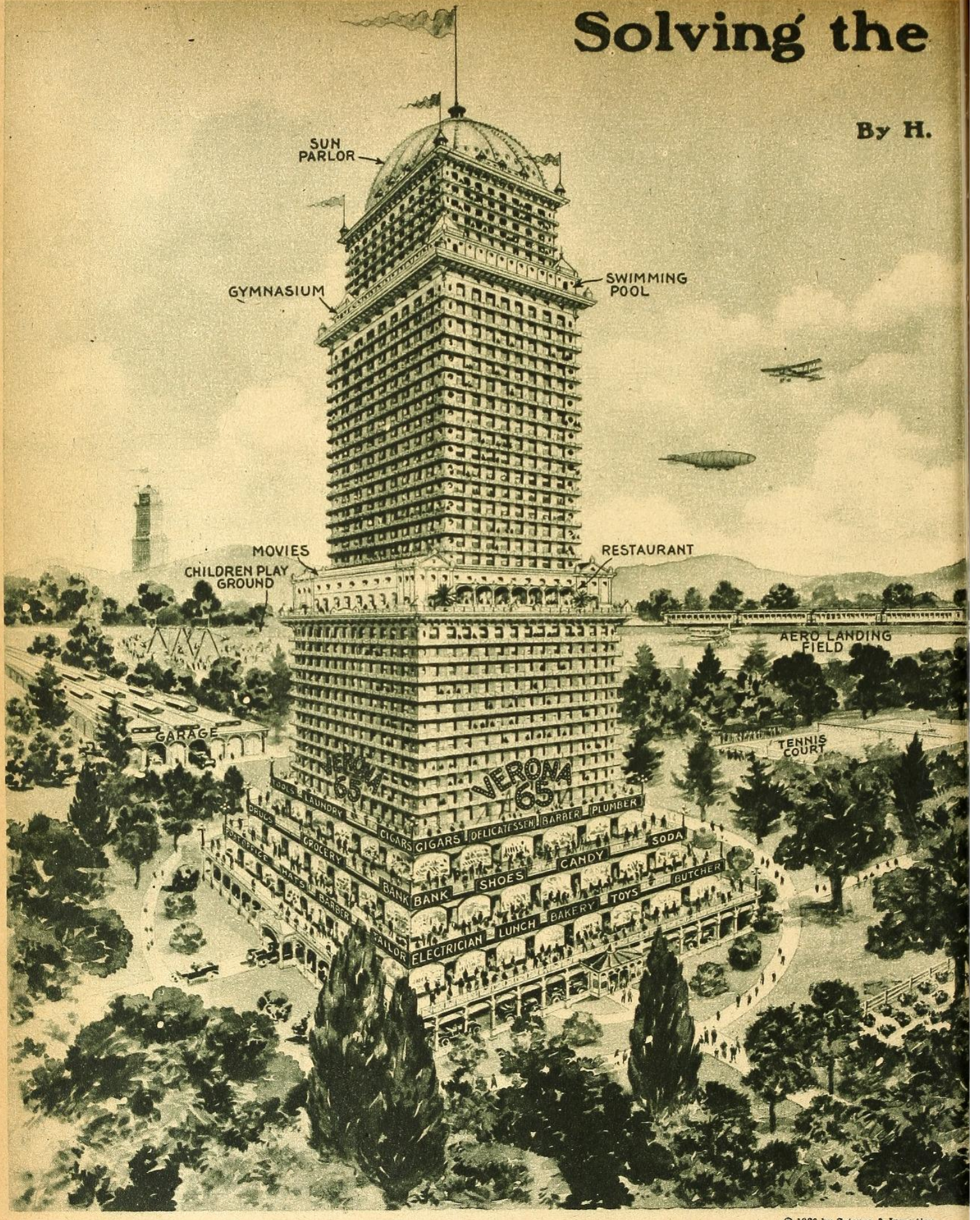
The mooring cable, which anchors the airship to the ground, carries with it telephone and electric wires, which means electric illumination and constant telephonic communication.

Food supplies as well as people are conveyed to and from the airship by means of an electric hoist in the forward car or cabin. Patients who cannot stand the elevator trip up to the airship can be carried up by an airplane ambulance in the manner here portrayed, the airplane landing on or hopping off from the giant upper deck easily.

The airship is usually held between 5,000 and 10,000 feet altitude. Here the air is pure and invigorating, and usually cool. There is a promenade around the outside of the patients' cabin where they may sit or walk. Here, everything is restful and quiet. Rain clouds usually form around 5,000 feet, so when they appear the airship is allowed to go above them.

Solving the

By H.



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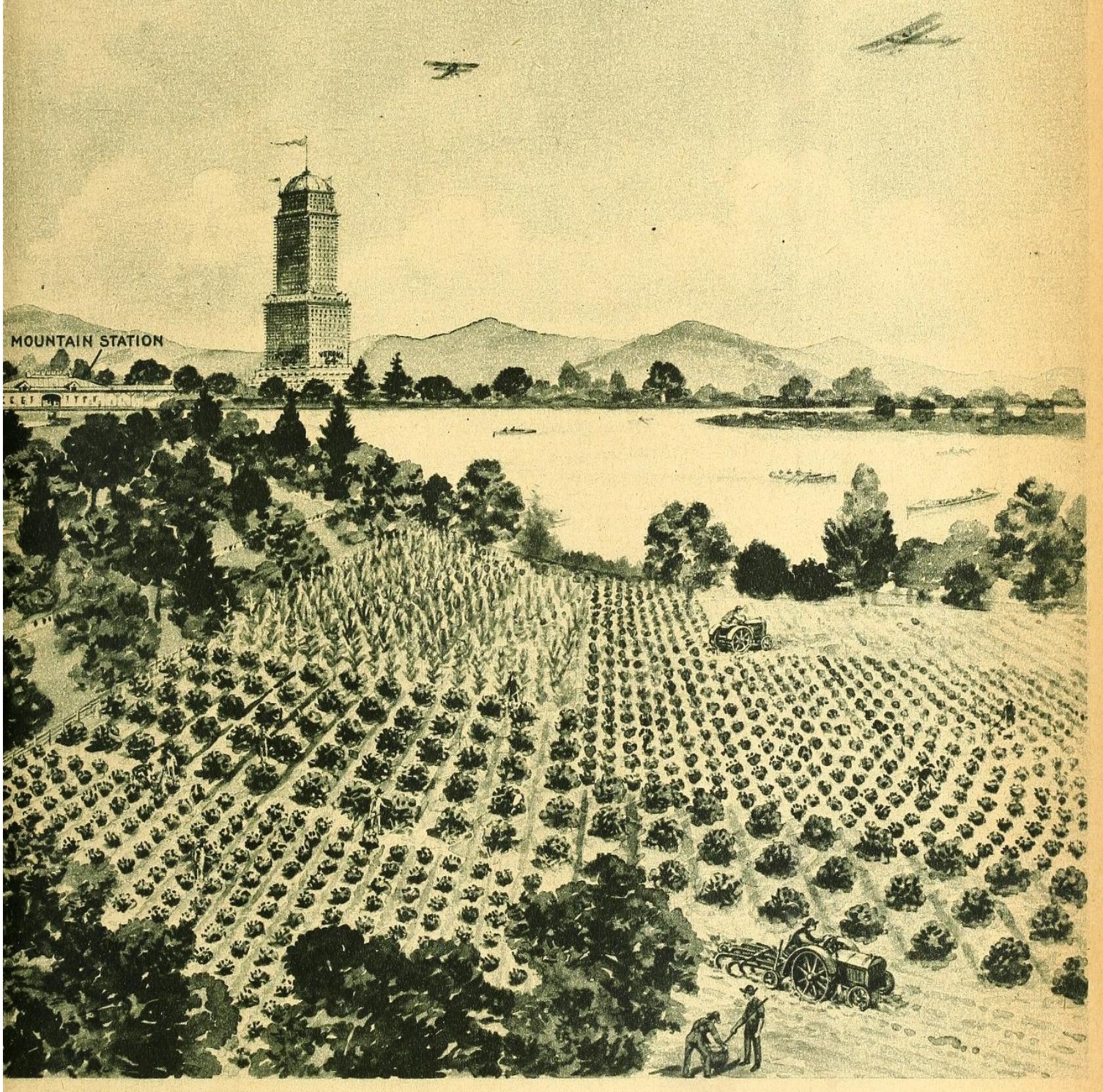
WE need hardly go into a lengthy explanation about the housing problem which confronts the majority of people at this time. It is not only a condition that prevails in the United States, but is universal all over the globe. Due to the war no new construction to speak of has taken place while the population has increased anywhere from ten to twenty per cent, depending upon the various nations. A condition has been created thereby which has become well nigh intolerable. Neither houses nor apartments are to be had. and those that may be had are prohibitive in price, indeed.

The average human being prefers the country to the city. He does not live in the city because he likes it, but because he has to for business and economic reasons, as well as for the sake of convenience. The man who lives in the country gets fresh

Housing Problem

GERNSBACK



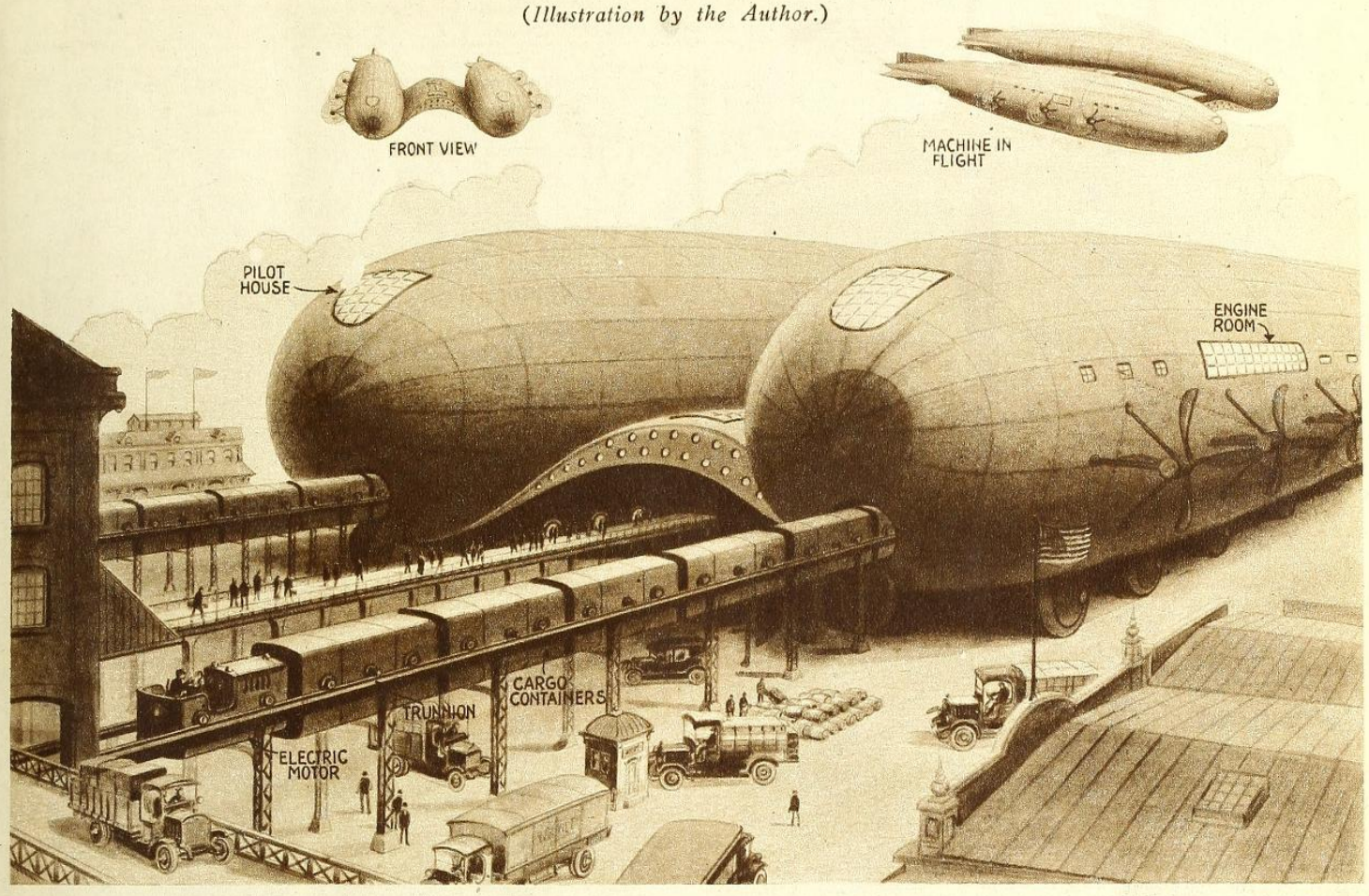
air, and fresh produce, while his children have ample room to play; moreover he has more room than his city brother. Against this it is charged that he has no convenience to speak of. He has to attend to his furnace, he has trouble in getting his coal, and he cannot buy all the things he requires in the little village or country place in which he resides. This makes for expensive transportation of small quantities of goods or other necessities. Moreover, in the average country town, there are few amusement places where a man may take his family. In the larger villages, to be sure, we have moving picture houses and the like, but in this case the village approaches again to the city size with all its congestion, high rent, etc. Moreover, many of life's necessities cannot be bought in the village, and are usually brought in from the city by the

(*Continued on page* 683)

Freight Loader for Airships

By GEORGE WALL

(Illustration by the Author.)



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When the Giant Airships of Tomorrow Arrive to Discharge and Take on Freight, Speed Will Be the Principal Desideratum. To Enable the Freight to Be Handled in the Shortest Time, So as to Keep the Ship in the Air, It Is Here Proposed to Pack the Freight in Metal Cars—These Cars Being Run in or Out with an Electric Locomotive as Shown.

As commercial aircraft routes continue to develop, one of the promising and important features of this method of transportation is that of carrying freight and express shipments, aside from that of passengers. We know that a large number of passengers may be quickly taken on board an airplane or Zeppelin type airship, but it is another problem altogether, when we come to consider the loading of a number of these large airships with freight in the near future, when aircraft will be as common a sight as the ocean steamships of today. The writer of this article has given considerable thought to this phase of the subject, and illustrates herewith an idea which he believes quite feasible, not to mention necessary, in rapidly loading such giant freight-carrying aircraft, so as to keep them flying the greatest amount of time possible.

It requires several days to load some of the large ocean steamships at the present day, even with the highly developed loading and unloading machinery which has been installed at several of our large sea and lake ports. The scheme shown in the illustration will certainly serve to load one of these giant aerial Leviathans much more rapidly than is possible or has proven possible so far in the case of steamships.

The principal idea in this arrangement is to have the freight placed or packed into suitable steel carriers or cars, each one to contain a given number of tons of freight.

The freight can thus be gotten ready to load into the airship long before the actual shipping time, and when the ship arrives, her shipment of freight could be pulled out with electric locomotives, running along the rails as shown in the picture, and the return shipment stowed away in her cavernous maw, all within a few hours.

Incidentally, the writer shows in his illustration herewith a new idea in dirigible or lighter-than-air aircraft design, *viz.*, this type of airship comprising two individual gas bags joined together by a more or less shallow central compartment, which can be made of sufficient height to form a passenger-carrying compartment with staterooms, etc., for the accommodation of passengers.

It would seem a very good plan to provide two pilot rooms in the nose of each dirigible as shown, which had best be equipt with suitable controls, in duplicate, for steering and handling the giant aircraft, so that in the event that one set of controls should become defective, the other set could be immediately brought into play.

This type of duplex airship should operate very successfully in the air and should not prove any more difficult to handle than a single gas bag dirigible.

One of the reasons for suggesting this invention in the design of lighter-than-air machines, has been prompted by the belief in the fact that the maximum size of single gas bag machine has been about reached in the giant craft built by the British, such as the R-34, which made a successful trip across the Atlantic Ocean, and return.

To carry more freight than the R-34, for example, it would be necessary to build a longer ship, as the diameter could not, of course, be very much increased, for the length already adopted in the design of the R-34. Hence, the present suggestion that two such gas bags be combined and rigidly fastened together in the manner shown, resulting in a ship of moderate length and easier steering and handling qualities.

Several other ideas which the writer has had in mind for the freight-carrying airships of tomorrow, are the following:

It has been found difficult to successfully repair gasoline engines used for driving the propellers of such aircraft when the engines are placed external to the gas envelope or cabins of the ship, and therefore it would certainly seem the best practice to place the driving motors inside the airship, grouping the engines as far as possible along a given axis so that the engineer crew could take care of the motors by passing from one engine room to the other quickly.

It is proposed to drive the propellers thru shafting and gears or they could of course be driven electrically by motors supplied with electrical energy from a central dynamo and gasoline engine plant, installed at a suitable location in the airship.

With this arrangement, the complete control of the airship is greatly improved and enables the centralization or focusing of all the engine power and other controls in the pilot's cabin.

The aircraft of tomorrow will duplicate, if not surpass, the large steamships of today in conveniences for the passengers. Wireless telegraphy and telephony apparatus will be carried, as well as all of the usual appointments.

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Science and Invention

H. GERNSBACK,- EDITOR
H. WINFIELD SECOR,- ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D.,- ASSOCIATE EDITOR

MARCH
1921
No. 11

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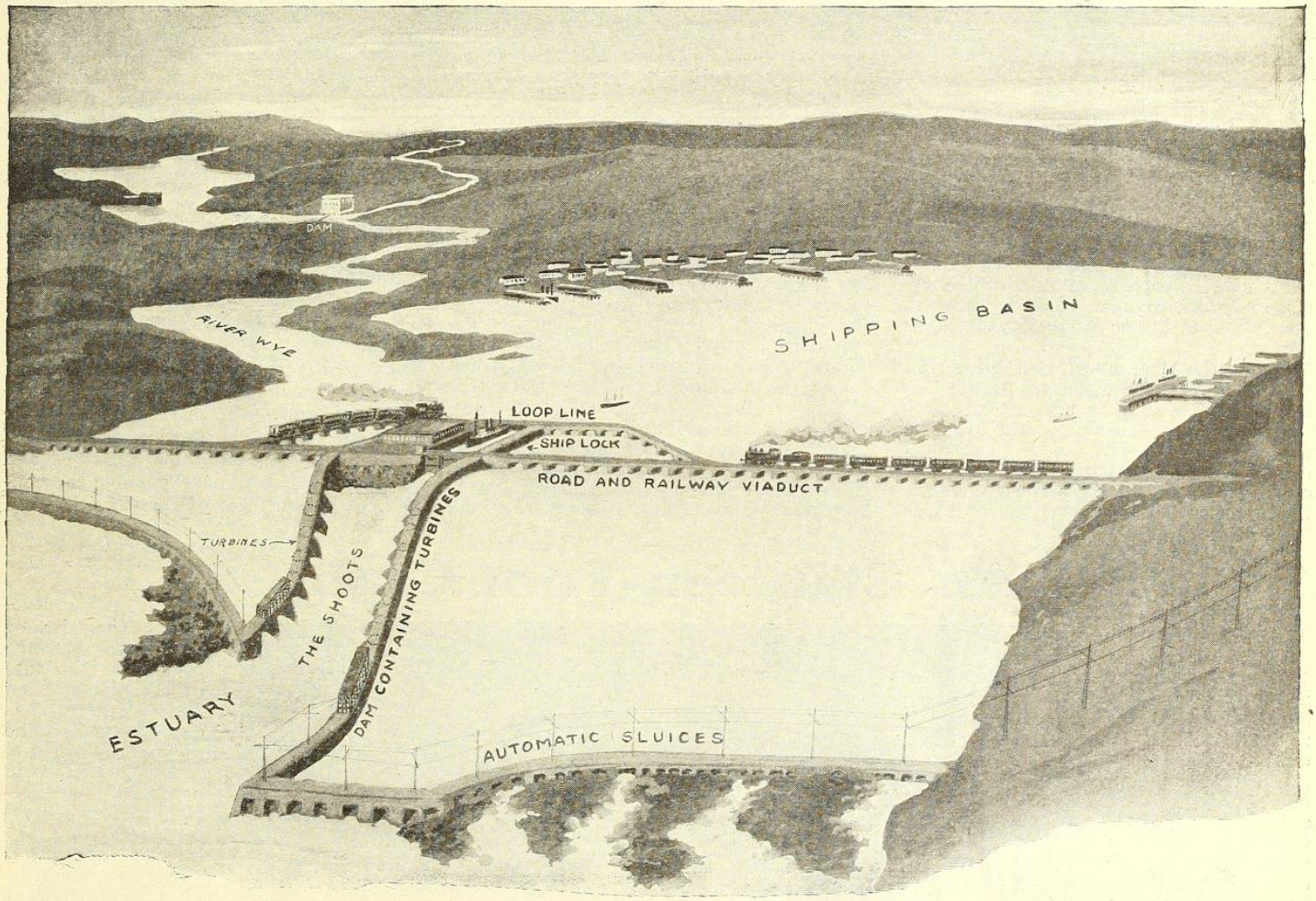
Utilization of Tidal Power in England and France

WE present to our readers, two schemes for utilizing tidal power, the one following the lines of a plan, originating in France, for a power station on the British Channel; the other a proposed installation of a very large size at the mouth of the Severn River, England. The estuary of this river is celebrated for the great rise and fall of tide, which brings about the formation of a bore.



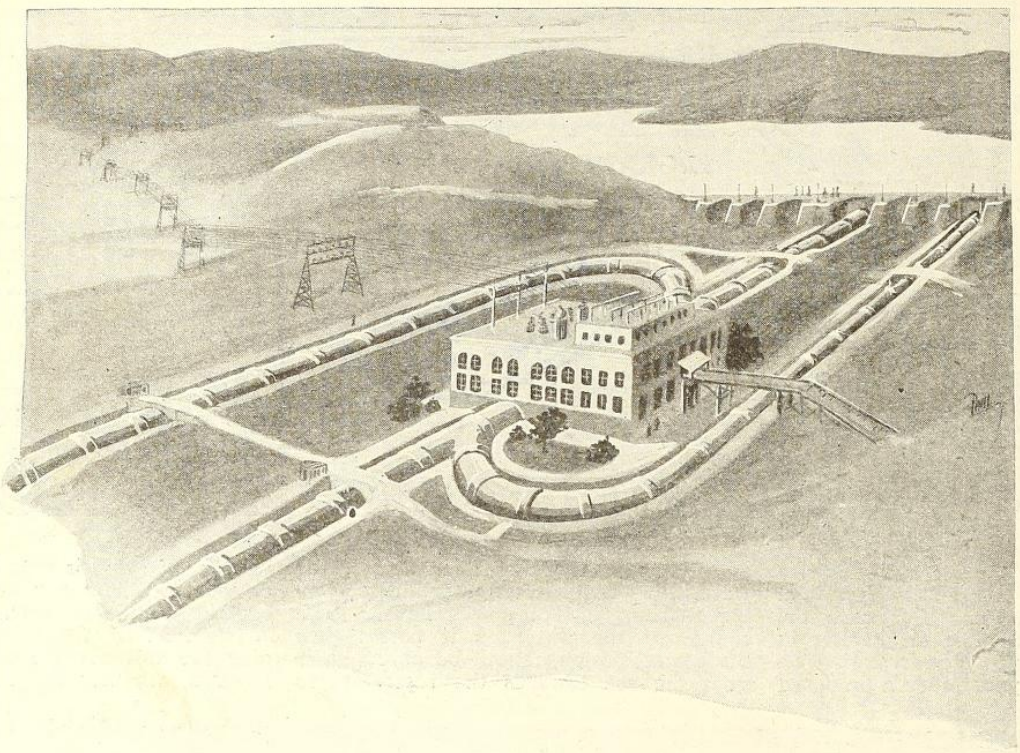
In England There Is Very Great Rise and Fall of the Tide. In the Severn Estuary a Thirty-Foot Rise and Fall Is to Be Utilized As Shown Above. A Half Million Horse-Power Is to Be Developed.

The idea of the French installation is by a system of conduits to admit water to an impounding reservoir as the tide rises. The water entering the reservoir passes thru pipes, and referring to the cut, with valves in the central line open and those in the side lines closed, the water flows in thru the central line actuating turbines in the power house. The course of the water as it passes thru the power station, it will be observed, is from the sea towards the reservoir, so that the turbines rotate in a sense determined by the direction of this flow. When the dam is full and the tide begins to fall, power is again developed by closing the gates in the central line and opening those in the side lines. The effect will be that the reservoir will empty itself and the flow of water thru the power station will be in the same direction, within the station, as it was before. Thus the turbines will always turn in the same sense, whether the tide is entering the reservoir, or whether the reservoir is delivering its contents to the channel.

The idea of the scheme is simply to give the turbines the same direction of rotation, whether the reservoir is filling or emptying itself. The above is perhaps little more than a suggestion but it at least carries out the idea of a uniform direction of rotation of the turbines in the power station.

We now come to the proposed Severn River installation. Taking advantage of any natural shoals the channel is to be dammed with provision of a shiplock plant. The dam whose line is determined by the natural contour of the river bot-

tom, provides, as will be seen from the cut, a wide channel leading to the lock. In the walls forming this channel there are to be installed turbines of a million maximum horse-power. The power which the turbines can develop will vary over a very large range. To the left of the cut is seen the River Wye, beloved by Cook's tourists, and far back in the interior there has been found an ideal site for the establishment of an immense lake or reservoir. This site it is proposed to dam and to connect it with the Wye by a tunnel; when the conditions are such that the turbines are exerting a million horsepower, half of it will be taken off and expended for filling the lake.



On the French Coast It Is Proposed to Install a Turbine Plant, Whose Rotors Shall Turn in the Same Direction for Rising and Falling Tide. We Illustrate a Suggestion for Doing This.

Under other conditions of the tide, when normal conditions would give the turbines very little power, the waters of the lake are to be drawn upon so as to bring the power up to the normal 500,000 horsepower.

Above the dam a railroad bridge and viaduct crosses the estuary. At the locks it is doubled so that one set of tracks passes on the ocean side of the locks and the other on the river side. The object of this arrangement is to give the trains continuous passage. In locking ships thru the gates it will be seen that one track or the other will always be closed. If but a single track crost the locking station it would have to be opened every time a ship went thru, thus introducing the trouble of intermittent passage for trains.

The method of energy storage, involving the use of the artificial lake, contemplates special turbines to be stationed in the vicinity of the lake so that, as the water is allowed to flow into the Wye, these turbines will give the power, which under the conditions of slack water the turbines in the Severn waters cannot supply. It is a most ingenious arrangement and would seem to contain a good suggestion for other similar locations. Offhand, a number of such power stations could be suggested, for on the coast of England, there are several localities which would seem open to this class of treatment.

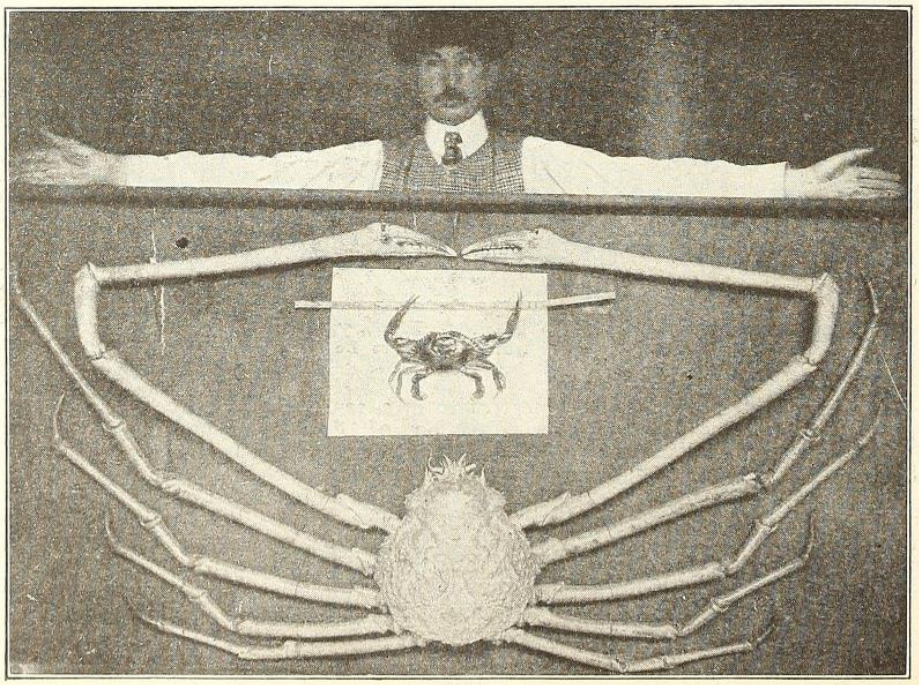
In the case of the "Severn Barrage," as the installation is called, an enormous amount of energy will have to be stored in the lake. The tunnel for its supply is to be driven thru over a mile of solid rock, and is to have a diameter of 40 feet, so as to be the largest thing of its kind in the world.

For such installations as these, if they are to be established on this side of the ocean, one's thoughts go at once to the northeast where in the state of Maine and in the provinces on the Bay of Fundy there are many ideal sites. Our readers will remember the famous waterfall in the Harbor of St. John, New Brunswick. This waterfall falls in opposite directions as the tide changes. Here one of the installations we have described as being designed for the British Channel, might indeed be put into successful operation. For many years, coal has been brought down from the provinces. Perhaps a time will come when power from the ocean will be distributed from the head of the Bay of Fundy where the enormous tidal rise and fall would seem to make possible the construction of an ideal power plant.

An Eighteen-Foot Crab!

HOW would you like to be in swimming at your favorite beach and suddenly find yourself in combat with a gigantic crab like the one shown in the accompanying illustration? This is not a reconstructed crab of prehistoric times, doped out in plaster and wood by a bespectacled theorist or student, but it represents what is said to be the largest crab in the world, and which was found in the sea-waters off Japan.

This enormous creature of the deep has tremendously large arms with pincers, which arms extend eighteen feet. The size of this huge specimen compared with that of an ordinary sized American crab is clearly show in the illustration.



This big crab, in order to escape being killed, when attacked by other large marine inhabitants, proceeds by the aid of his pincers to plaster and cover his whole body with various growths and seaweeds, et cetera, until he resembles a bit of the sea bottom itself, thus evading his pursuers.

The relative size of the giant crab is also demonstrated vividly by its comparison with the man shown standing with arms extended.

Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

Vol. VI. Whole No. 65 SEPTEMBER, 1918 Number 5

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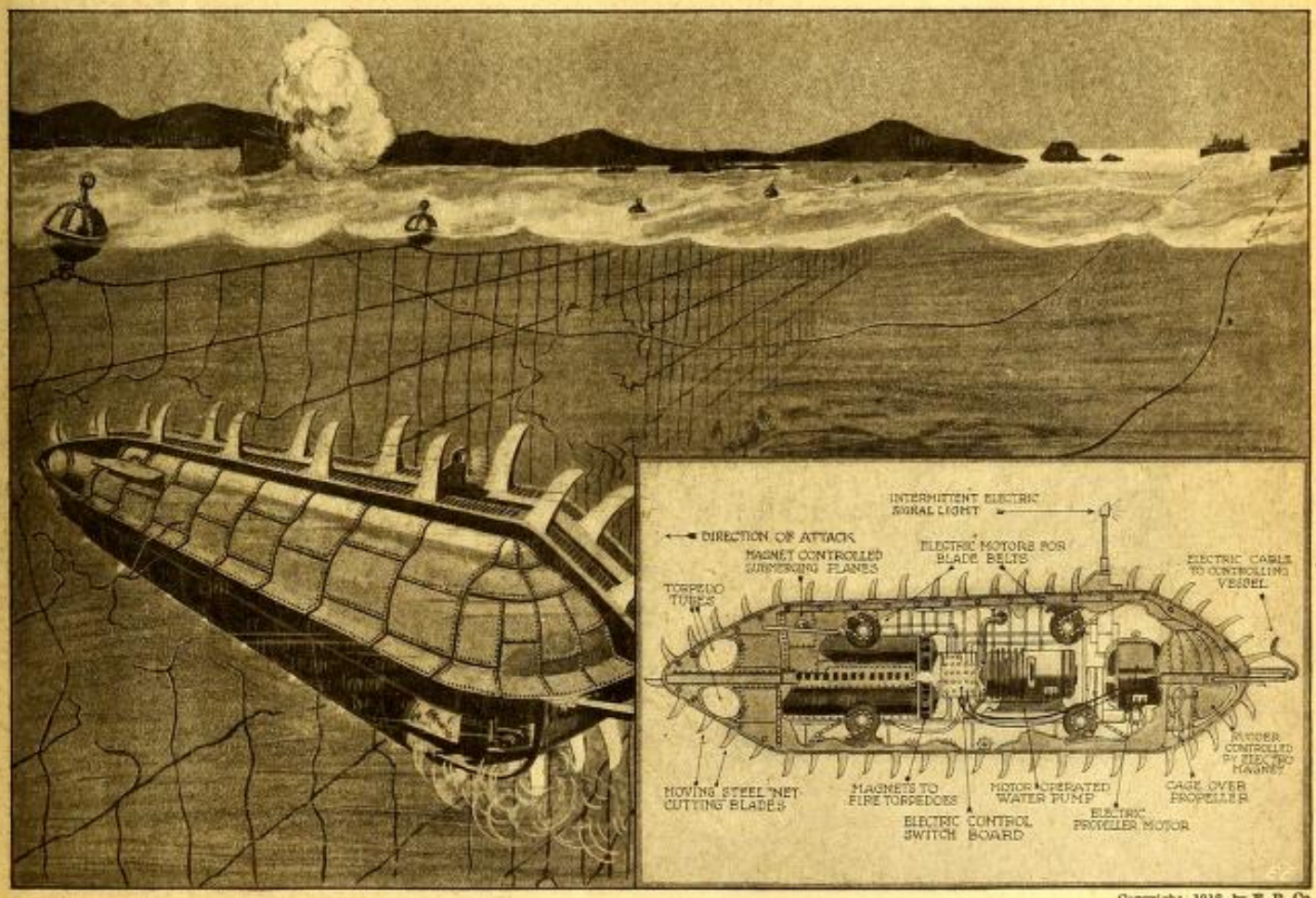
How the Electric "Sea Tanks" Raided Pola

By H. WINFIELD SECOR

THE very latest war-time animal is the electric "Sea Tank" as used by the Italians in a recent naval raid on Pola, Austria's famous naval base. From the information available on this latest hybrid among war-time offensive devices, it is learned that the Sea Tanks measure about forty feet in length and six feet in width, and that they are propelled by electricity. Further, as our illustration herewith shows, these Sea Tanks are provided with an endless rotary chain, running lengthwise around the vessel, these rapidly moving chains being fitted with sharp steel barbs or knives which can cut their way thru nets and other obstacles just like their prototypes, the land tanks, first used so effectively by the British. This under-water demon is provided with several torpedo tubes at the bow, and from all accounts, it seems that the device was crewless, and operated by means of electrical control currents sent thru a flexible insulated cable connecting with a war vessel, which latter nosed its way up to within a few miles of the steel nets guarding the harbor of Pola.

The account of the attack on Pola by the Italian Sea Tanks states that they bored their way thru the heavy steel nets spanning the navigable approaches to the port, within which there lay at anchor Austria's fighting fleet, and that a mighty Austrian battle-ship of the *Virubus Unitis* type of about twenty thousand tons displacement was torpedoed.

The detail illustration herewith shows the probable arrangement of the interior of the Italian Under-water Tank, also the arrangement whereby the steel belts carrying the net-cutting knives or barbs are driven by powerful electric motors, which obtain current from a storage battery carried in



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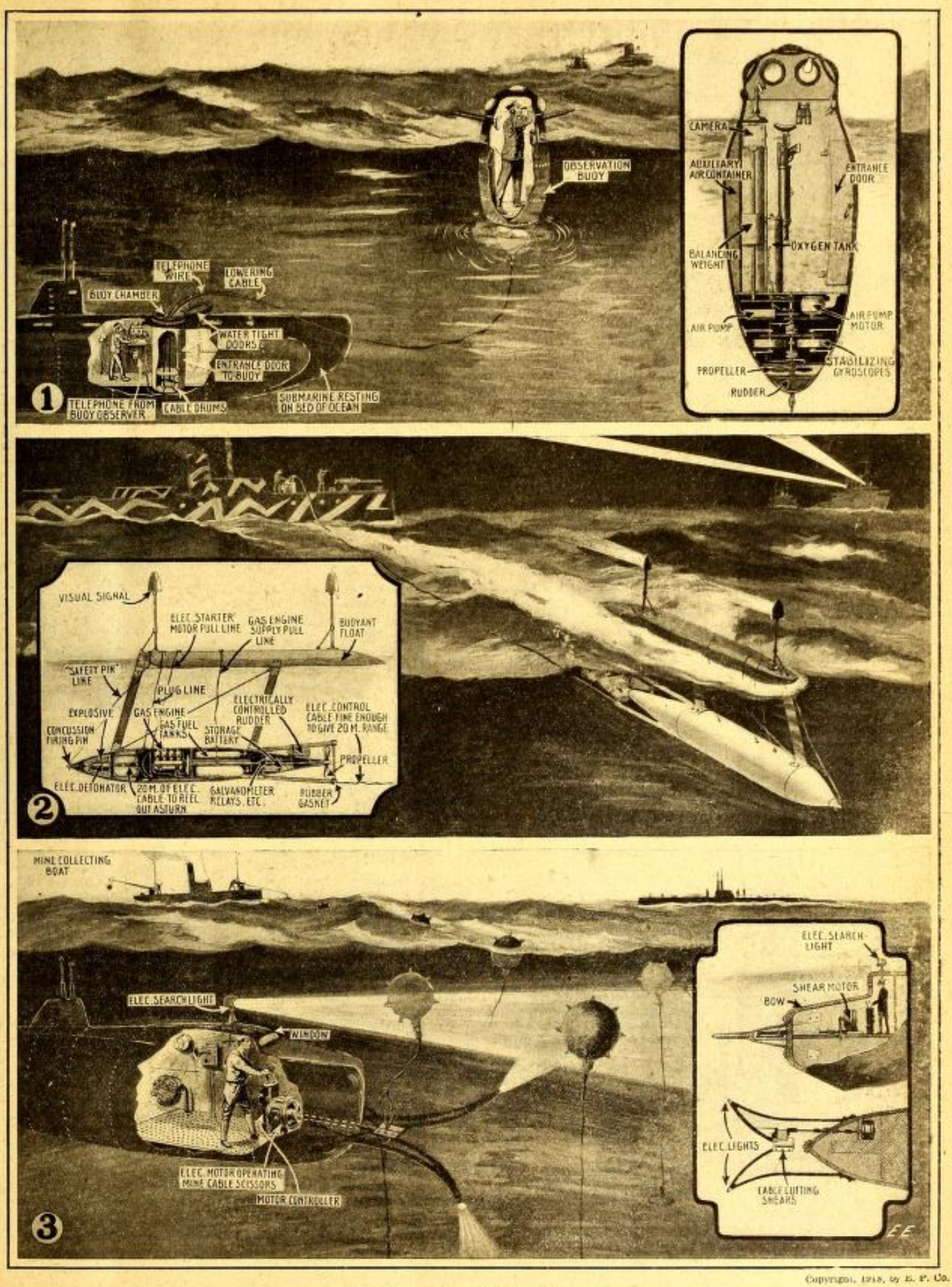
The Italian Navy Recently Carried Out a Remarkable Attack On Pola, Austria's Famous Naval Base, in Which the Latest Engine of War, The Electric "Sea Tank," Played the Leading Rôle. These Monsters with Their Net-Cutting Knives and Controlled by Electricity from a Mother Ship, Past Thru All the Harbor Barriers and Blew Up a 20,000 Ton Battleship.

NEW ELECTRICAL IDEAS ON SUBMARINES AND TORPEDOES



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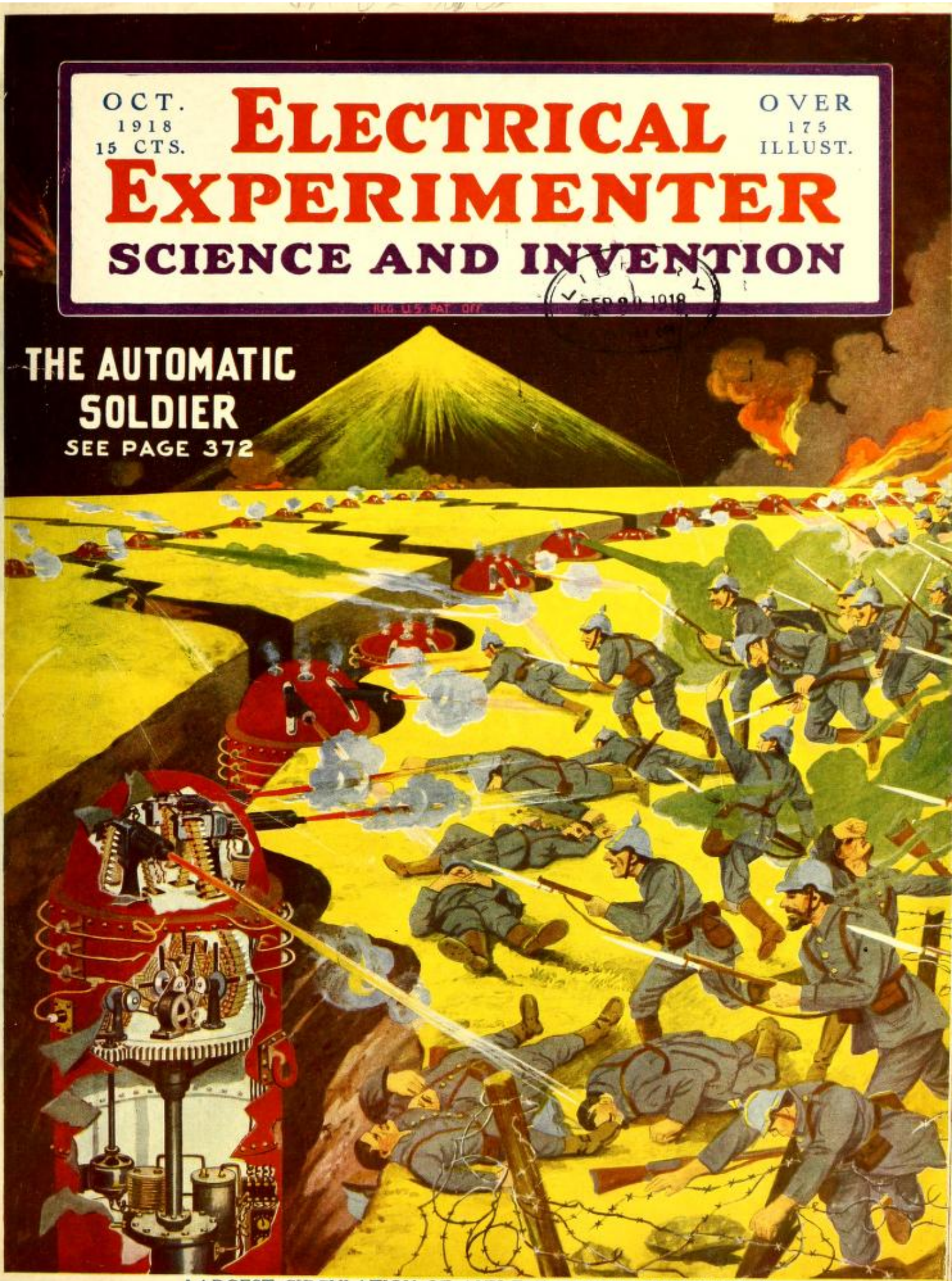
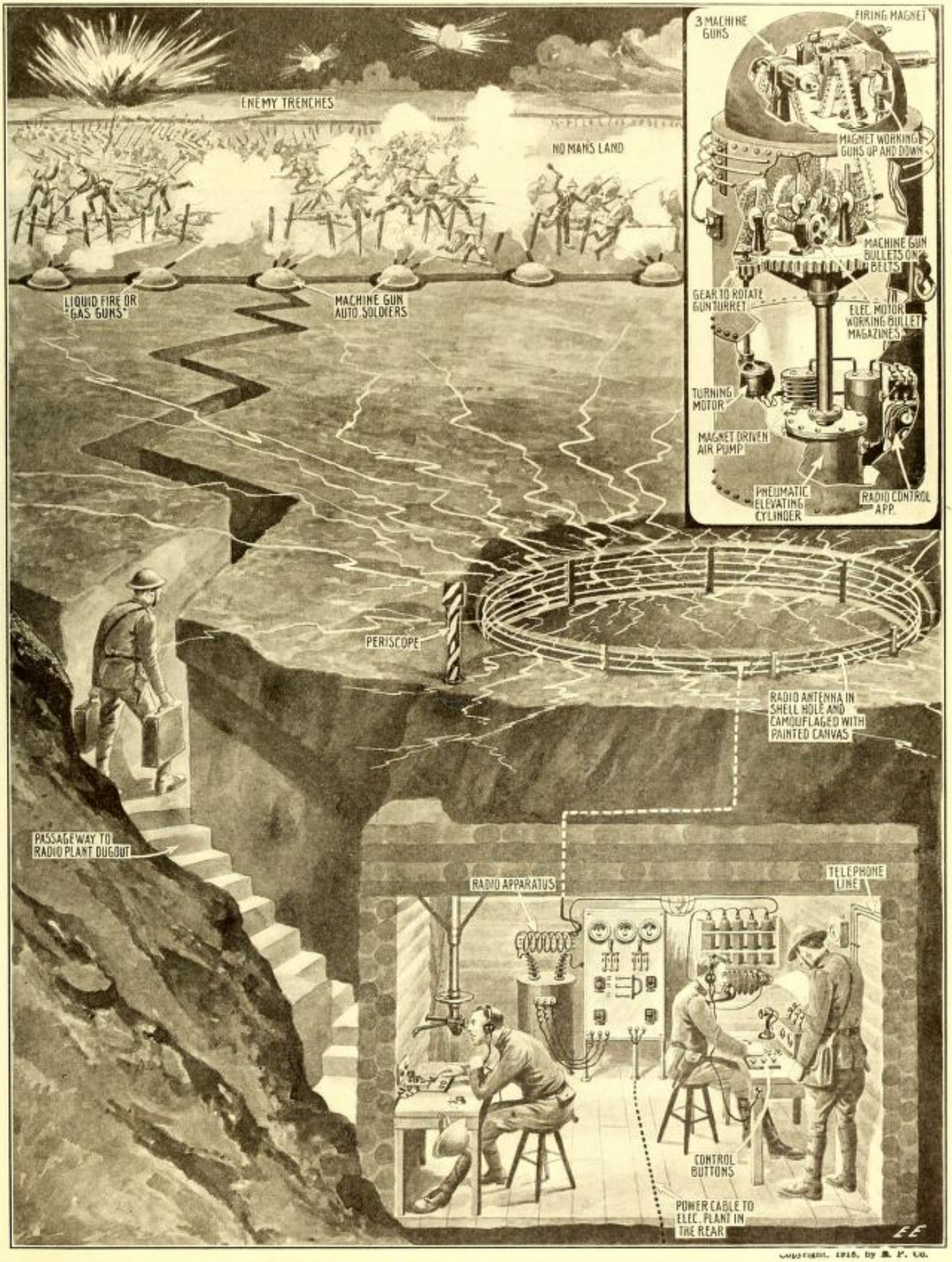
THE AUTOMATIC SOLDIER

SEE PAGE 372



LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION

THE AUTOMATIC WIRELESS SOLDIER



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The Latest Brilliantly Conceived and Patented Military Weapon Is the Bullet-proof "Automatic Soldier." Loaded Up With Triple Machine Guns For Shooting Bullets, Liquid Fire and "Gas," and Finally—Controlled By Radio From a Bomb-proof Dugout—This Death-Dealing Invention Promises to Revolutionize Modern Warfare on Land.

The Automatic Soldier

By H. GERNSBACK

As science advances, and as all sorts of infernal machines are thrown into a modern war, the men in the front line trenches become less and less anxious to bear the full brunt of high explosive shells, gas attacks, liquid fire and what not. No matter how courageous a body of soldiers, their morale is bound to deteriorate considerably under a murderous mustard gas attack, or under a modern barrage.

As has been so often demonstrated in this war, if the men in the first and second line trenches can be demoralized, the enemy as a rule can tear quite a gap into the lines, and make his assault in strength. If we could devise some sort of a soldier who was bomb and shell proof and who did not mind either liquid fire or the most vicious kind of gas, our front line trenches would be very much more secure than they are now. It would be difficult to storm such trenches.

This is exactly what a Danish engineer has had in mind when he recently obtained patents on a device which he terms an "Automatic Soldier." Trials recently made with a model automatic soldier are reported to have been eminently successful.

Our front cover as well as the accompanying illustration shows the device clearly. The automatic "soldier" briefly consists of a special double steel cylinder made of shell-proof Tungsten steel or the like. There is one outer, stationary cylinder and a second inner cylinder, the latter telescoping into the stationary one. The entire device is set into trenches as shown in our illustration, the contrivance taking the place of a human soldier. These automatons may be spaced from one to three yards apart, and the operation is as follows:

As already mentioned, there are two cylinders—one, the outer, in the form of a can, and the inner one, in can-shape, too, but with a dome at the top. The inner cylinder rises up and down vertically and normally the dome is level with the surrounding land. When the "soldier" goes into action, the inner cylinder rises eighteen inches, which brings it above the parapet of the trench. In other words, the automatic soldier normally is invisible, and only can be seen when the inner cylinder rises. The guns as well as the entire mechanism are entirely controlled by wireless, operated from five or more miles at a distance. If the commander wishes to open battle with his automatons—after the aerial observer has reported the approach of the enemy—he merely notifies his wireless control station, which immediately sends out impulses, and these in a well-known manner operate the automatic soldier.

The first impulse raises the inner cylinder above the trench. The second impulse pushes the machine guns thru the slots of the dome, while a third impulse may rotate the inner cylinder so as to direct the fire. The fourth impulse may set off the machine guns, each of which, according to its inventor, is able to fire four hundred rounds into any given direction.

Our front cover shows the disposition of the aerial wires which encircle the main steel cylinder.

It goes without saying that the fire of the machine gun can be stopt by radio by sending out the correct impulses at any desired moment. The aerial observer flying over the trench lines containing the automatic soldiers sends back his wireless reports so that the fire of the automatics can be directed where it does the most good. The action of the device is such that the instant the guns stop firing, the inner cylinder immediately sinks into the outer one, thus disappearing from view. It goes without saying that these automatons cannot only be used to pump bullets into the oncoming enemy, but they can be used as well for other purposes—such as to belch forth liquid fire or to let loose a gas attack as depicted in our cover illustration. Perhaps it would not be a bad idea to equip every sixth automatic soldier with a poison gas tank, all of which will certainly tend to stop the most gallant as well as vicious attack of the enemy.

While machines of this kind seem very cumbersome, and perhaps not efficient, because it may be argued that they cannot think, nevertheless they would often be very much more valuable than the average soldier. For one thing, the machine knows no morale—it never retreats. It is not much affected by rifle bullets, and only a direct shell hit during a barrage will put the automaton *hors de combat*.

The automatic soldier is not dependent upon the rear for victuals, as the only thing it eats is munitions with which it can be supplied at night by way of the trenches. It is not affected by shell shock nor mustard gas, and liquid fire has no effect upon it. It never surrenders and never turns traitor. In order to be overcome, the automatics must be destroyed one by one, possibly only by exploding large quantities of T.N.T. against its sides. As long as the ammunition lasts no soldier would care to approach it, as he would never know when the wireless would set it off, which would immediately bring the automaton into action, no doubt killing the attacker.

It is difficult to see how ordinary infantry could overcome these automatics if planted three or four lines deep. Each trench line would have to be won at tremendous odds, and there is not a soldier living who would stand up under the withering fire of such automatons who know no fear.

A device of this kind is, of course, not chimeric, but entirely within the realms of present day science, and we would be very much surprised, indeed, if the automatics would not make their appearance soon at strategical points along the front. Nor are they difficult or expensive in construction, each one of the automatons not necessarily costing more than five or six thousand dollars, which is but the price of a modern torpedo. The wireless apparatus does not take up much room, while the motors which drive the entire mechanism may be readily operated by a 24-volt storage battery placed at the bottom of the large cylinder. All the rest of the mechanism is readily worked by comprest air which can be replenished easily at night after the automatics have gone into action during the day. This is the case also of ammunition, gas or chemicals for liquid fire, all of which can be replenished during the night time by men walking up to the machine thru lateral trenches.

Of course if there was no action during the day, there would be no need for replenishing anything

It should also be understood that these automatics can be operated singly or in groups by means of electric cables buried into the trenches, if it is preferable to use this method instead of the not always so reliable wireless.

HISTORY OF THE RELAY WHEN "HUN" MET "YANK."

There is a curious fact connected with the history of the telegraph relay. It could not be patented in Germany, and therefore could not with safety be exposed. In 1848 two young Americans named Charles Robinson and Charles L. Chapin had gone there with Morse apparatus to try their fortunes in building lines. Wheatstone had a dial instrument in use on a short railroad line, but its action was feeble and unsatisfactory. Robinson and Chapin built a line of telegraph from Hamburg to Cuxhaven, a distance of ninety miles, by which to transmit marine news. The magnets, however, were carefully locked up in boxes, just as Alfred Vail did in Washington and Philadelphia. The line worked well. The registers clicked out loud and strong at either end. The German electricians scratched their heads and wondered. Finally, Steinheil was sent to make observations. He was a man of genius and culture and had a sort of telegraph at work in Europe before Morse in America. He looked carefully around, and his keen eyes soon saw the locked boxes. He asked to see their contents. But the view was courteously declined. So he turned and complained that the Yankees kept their secret locked, but that the action was magnificent. When, however, at a later date, he did finally know all, he gave Morse his hand, confest himself beaten, and the two were friends forever after.

HAS ANYBODY HERE SEEN S-P-E-R-R-Y??

Would you believe that "Sperry" was your good old friend the EXPERIMENTER in a new dress? Of course you wouldn't! But then you see it is like this: All is not gold that glitters and everything does not read as it sounds, hence we have EkSPERRYmenter! In other words, "SPERRY" is a new nickname for your good old friend "EXPERIMENTER". Now we admit that in our dull way of thinking, we never had an idea like it, and it had to come all the way from Malvern, which lies in sunny Australia, to put us wise to it. It also appears that the nickname for the "EXPERIMENTER" is "Sperry" in Australia. If you don't believe it, read the following:

Editor, ELECTRICAL EXPERIMENTER:

I have been reading the ELECTRICAL EXPERIMENTER now, for about two years, and I think it is absolutely the finest magazine on Electricity and Wireless. Long Life to "*Sperry*" as it is called out out here. I notice that it is going up in price (for Australia) with the next issue. Well, I'm sure I (and anybody else) don't mind paying double the price that it is going up to, I am, sir,

Yours truly,
(Signed) S. ROBINSON,
87 Dandenong Road,
Malvern, Australia.

Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

Vol. VI. Whole No. 66 OCTOBER, 1918 Number 6

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OUR NEW 400,000 C.P. AEROPLANE FLARES

FOR carrying out night operations under war-time conditions the Teutons, as well as the Allied air forces have often resorted to the use of "flares" as they are called. These are usually dropt from airplanes or dirigible balloons and, suspended from parachutes, they give an intense illumination over considerable areas.

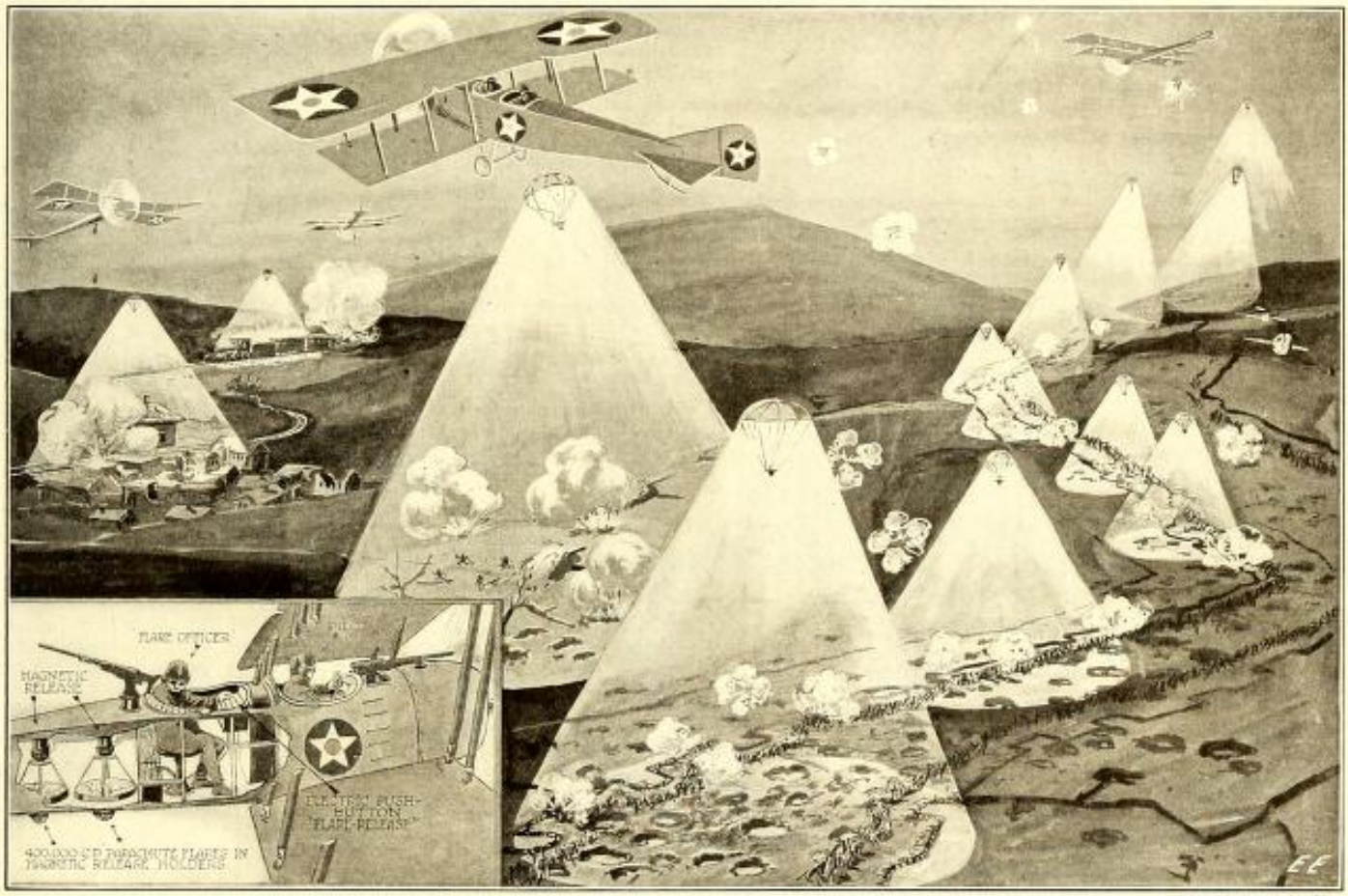
Uncle Sam's ordinance experts have something new to spring on the "All Highest" shortly—a new "flare" light that will give 400,000 candle-power, and light up a circular area one and one-half miles in diameter!

An airplane flare with a brilliancy equalling that of 400,000 candles has been perfected, says our official report from Washington. When hanging from its parachute over a German munition plant it lights up an area so brightly that an airman, thousands of feet in the air, can select any building he is directed to make a target for his aerial bomb, and, it may be added, American aviators are becoming so expert in bombing that they can usually hit the target at which they shoot.

In every European city within the zone of aerial raiding operations, the rule is rigidly enforced against the burning of lights in any building that might possibly be used as a target. Therefore, the airman must be able to supply his own means of locating the object of this attack.

When orders are received to bomb, say a particular railroad center, the aviator proceeds very much in the same manner as does the captain of a vessel. The cities and their environs are charted and the night-flyer proceeds by compass, due allowance, of course, being made for atmospheric conditions. He is also frequently aided by prominent markings, such as the reflection of moonlight from a river.

Having reached the particular district



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Uncle Sam's War Experts Have Recently Evolved Something Entirely New in "Flares." This Design Permits of Launching the "Flares" from Aeroplanes, and the Powerful, Prolonged Illumination They Provide Will Make the Visit of our Nocturnal Aerial Bombers One of Extreme Anxiety to the Inhabitants of German Towns and Cities. Each "Flare" develops 400,000 Candle-Power and Lights up an Area One and One-Half Miles in Diameter.

Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

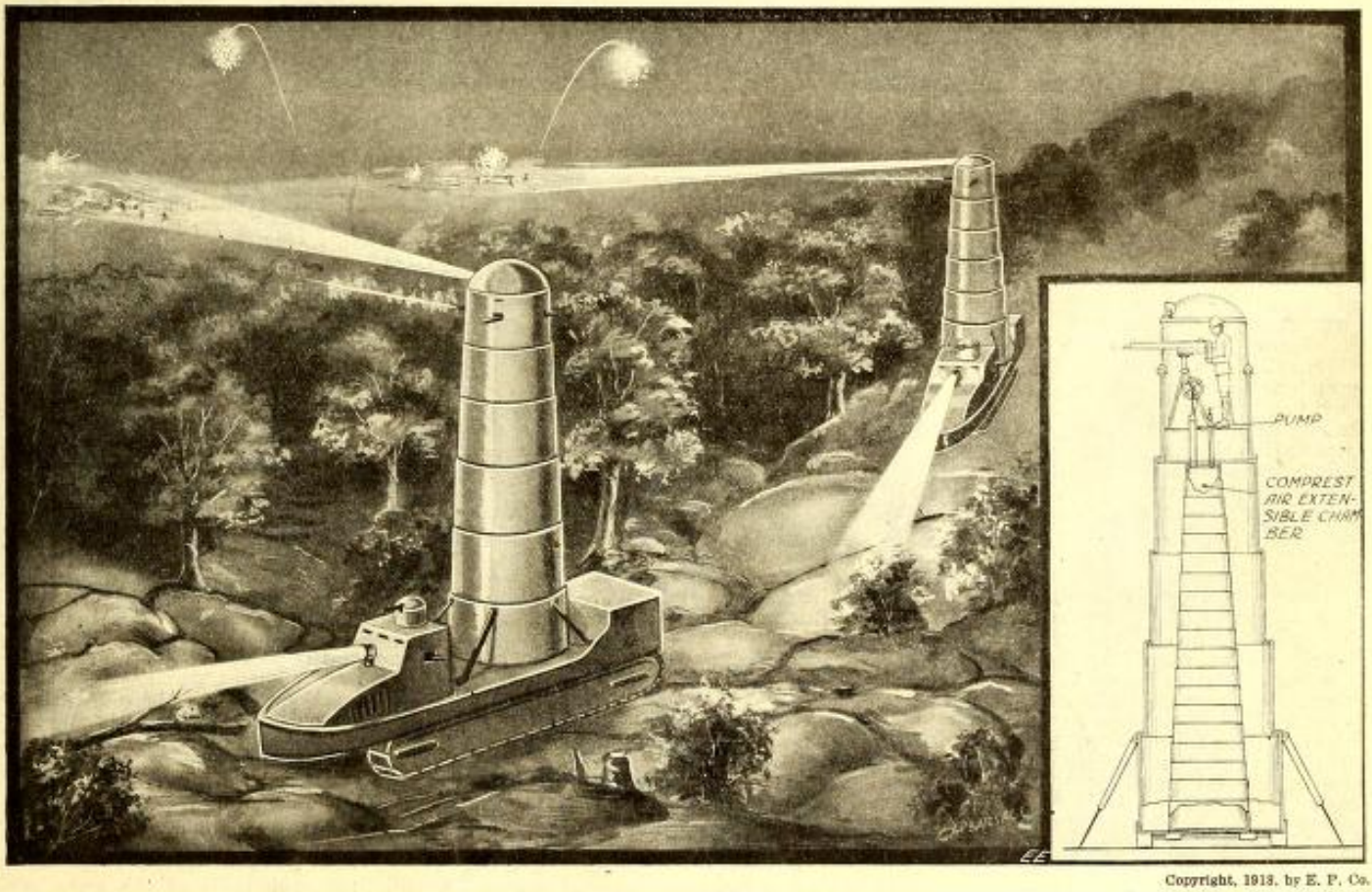
Vol. VI. Whole No. 68 DECEMBER, 1918 Number 8

NOV 26 1918
U.S. PATENT OFFICE

At Last the Super-Tank!

HERE at last we have the super-tank. It was recently thought out and patented by one Anton Krzan of Chicago. This military device has considerable possibilities, and its field of activities is a wide one. It may be mounted on a powerful automobile truck or chassis, so as to be kept rolling over the country at high speed, and the while hurling forth streams of machine gun bullets, not to mention liquid fire and gas. This armored telescopic tank may carry searchlights for use at night. It can also be used as an observation post for the Signal Corps. Of course, this armored tower could be well camouflaged so as to be hardly discernible even a few hundred yards away.

The inventor describes one way of elevating the steel tower, whenever so desired, by the use of comprest air. He states that one man can elevate the tower section by simply turning the handle on a small air pump which compresses air at atmospheric pressure and forces it into a flexible chamber, which, as more and more air is pumped into it, naturally causes the tower sections to rise correspondingly. Where the super-tank is mounted on an automobile chassis, several other methods at once become available for elevating the tank as often as required. One of these is to connect it mechanically with the automobile engine thru suitable clutch mechanism and gearing. Another method is to have a separate gasoline engine unit, just to raise the tower section of the tank—and still another way is to have an electric motor inside the tower base, the motor receiving electric current to operate it from a storage battery charged from the automobile engine. A further scheme for such a power plant would be that involving the use of the automobile engine to drive a



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At Last the Super-Tank! A Yankee Genius Has Developed This Telescopic Armored Tank for Use in Ferreting Out the Enemy, Making Observations, and Breaking Up Airplane Attacks Close to the Ground. Equipt with Wireless Telephone, Searchlights, Machine Guns, and a High Speed Tractor Chassis, These Fighting Giants Should Prove Quite Formidable.

3,000,000 Fish an Hour Without a Hook

"ANY luck?" asks the habitual human machine gun. You can only answer him and say, "Yes, several thousand bites from our mutual friends the mosquitoes, but not a bite from the wily fish." It is the same old story, but not so with the new Giant Fishing Machine, designed and originated by one Captain N. A. Lybeck, a sturdy follower of the sea from coast to coast. While on one of his numerous adventures of the deep, he was thrown into close relationship with an unknown specie of deep sea fish that had a searchlight eye with the properties of "mesmerismic" influence. After his safe extradition from this catastrophe he evolved the idea that this fish must exercise a hypnotic influence over its prey and here was the birth of his great idea,—namely, a giant fishing machine which would "hypnotize" the fish with powerful electric searchlights and a scooping device which would run in the fish to the sorting tables; in other words, an electro-mechanical fisherman on an enormous scale.

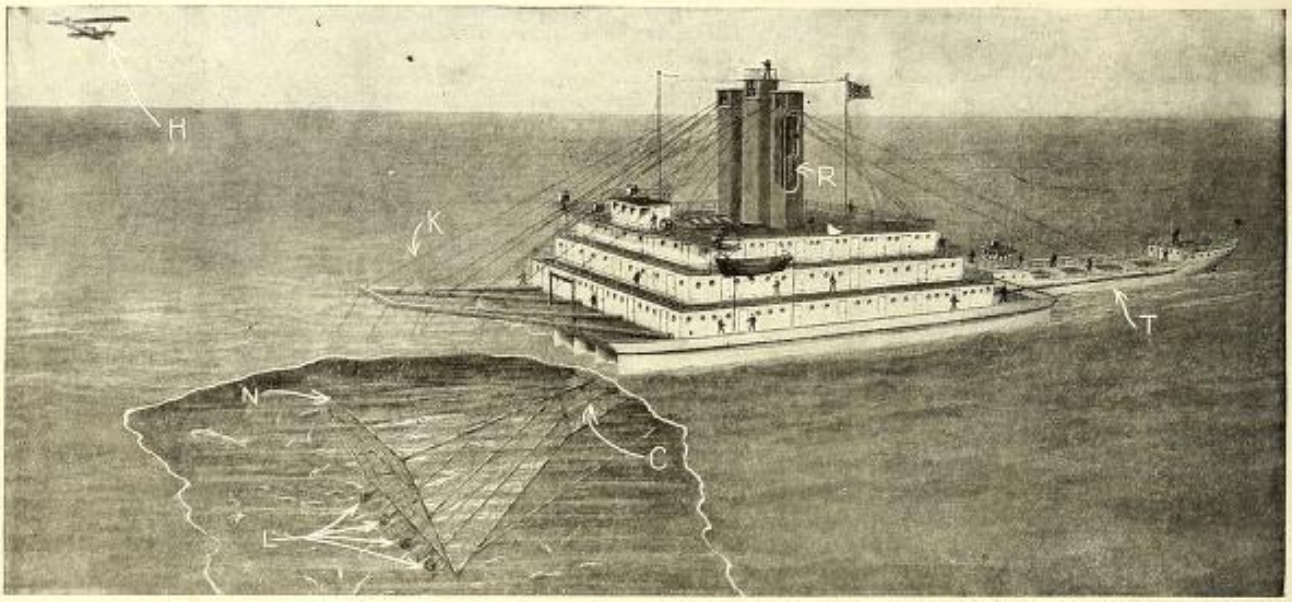
How successful he has been can be judged from the illustration of his monster Fisherman. In action its operation can be described as follows:—When the engines are working and forging the boat ahead at the rate of ten miles an hour, this forward motion causes fish to be carried into the scoop and thence thru the throat of the scoop onto the electric conveyor, which carries the fish to the electrically operated sorting machine, where the different varieties and sizes are sorted, separated and sent on to the different respective packing bins.

The best of the selected fresh food fish are immediately, while still fully alive, frozen into solid blocks of ice in an electric refrigerating machine. The Government Bulletin that has been issued on this subject of cold storage lays stress on the fact that either the packing of a perishable article in ice or the refrigerating of the same by a cold producing machine will positively preserve the article in its exact condition at the time of refrigeration. Therefore if the fish are absolutely fresh when they are placed into the ice-making machine and frozen, then they necessarily must be absolutely fresh when the boat is landed and the fish unloaded for consumption by the public.

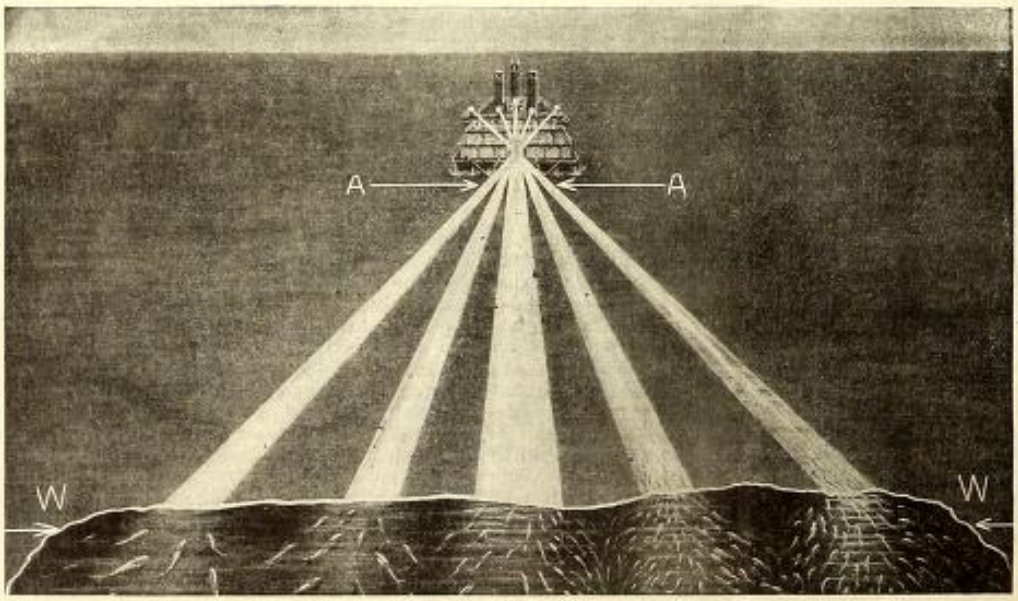
All fish that are of desirable qualities but are too small for use are allowed to pass uninjured back into their native element, where they may increase in size and numbers. This is made possible by the construction of the fishing machine and its scoop. The fish are caught and carried forward without any sort of injury; therefore if they are not of the kind that are wanted or are diminutive in size they can be returned and none the worse for their experience.

The hulls of the boat are tunnelled and streamlined so as to eliminate any disturbance of the water, which in some way or another gives notice to the *sixth* sense of the fish, if they have such a sense, that danger is lurking nearby. For that very reason you could have killed Towser when you brought him on that last fishing trip and while comfortably smoking your favorite meerschaum he started to bark and run up and down the bank of the stream, scaring all of the fish away from your

(*Cont. on page* 584)



Catching 3,000,000 Fish an Hour, Without a Hook! Sounds Impossible, Doesn't it? That's What We Said Until We Saw the Machine Work. It First Hypnotizes the Fish, Millions of 'Em, by Its Powerful Electric Searchlights; the Advancing Scoop-Net Whirls the Finny Victims Up to an Electric Conveyor and Sorting Machine.



Head-on View of the Giant Electric Fisherman, Its Powerful Searchlight Hypnotizing the Helpless Fish, Preparatory to Gobbling Them Up In Its Scoop, Measuring 150 Ft. by 100 Ft.

Producing Rain by Electricity and X-Rays

FROM time to time in the world's history, there have been schemes promulgated for and attempts made at producing rain by artificial means under the control of man. One of the most promising of the recent schemes for producing rain-fall at any desired time, providing there happened to be aqueous particles contained in the atmosphere, is that due to an Australian scientist, John Graeme Balsillie. He has taken out patents on his system of producing rain-fall electrically, and one of his latest American patents is here pictured and described.

The illustration shows how Mr. Balsillie proposes to send up a series of balloons or large box kites of sufficient size to carry an extra large X-ray tube, and also capable of supporting two thin electric wires of considerable length. As the inventor states in his patent, his invention "consists in electrical means for assisting and promoting under suitable meteorological conditions the formation of aqueous particles in the atmosphere and assisting in promoting the deposition of water particles (rain-fall) from the atmosphere, and further to provide suitable apparatus for producing the necessary electrical conditions for that purpose." This balloon may be controlled from a motor truck which can speed over the country to various points wherever it may be desired, and a portable gasoline engine and dynamo outfit on the truck may supply the necessary current for operating the powerful X-ray tube carried by the balloon, as shown in the illustration, and also for developing the high potential current, about 350,000 volts, which is employed for *charging the metallized surface of the balloon.*

As has been pointed out in previous articles on similar inventions in this Journal, —and as substantiated by the opinion of several well-known scientists, included Dr. Henryt Arctowsky, the Arctic explorer, of New York,—the inventor informs us in his patent that his discovery is susceptible to practical use *only* when the cooling of aqueous vapor resulting from its expansion in elevated regions of the atmosphere and other natural influences brings the vapor *above the saturation point*, so that *condensation* becomes possible.

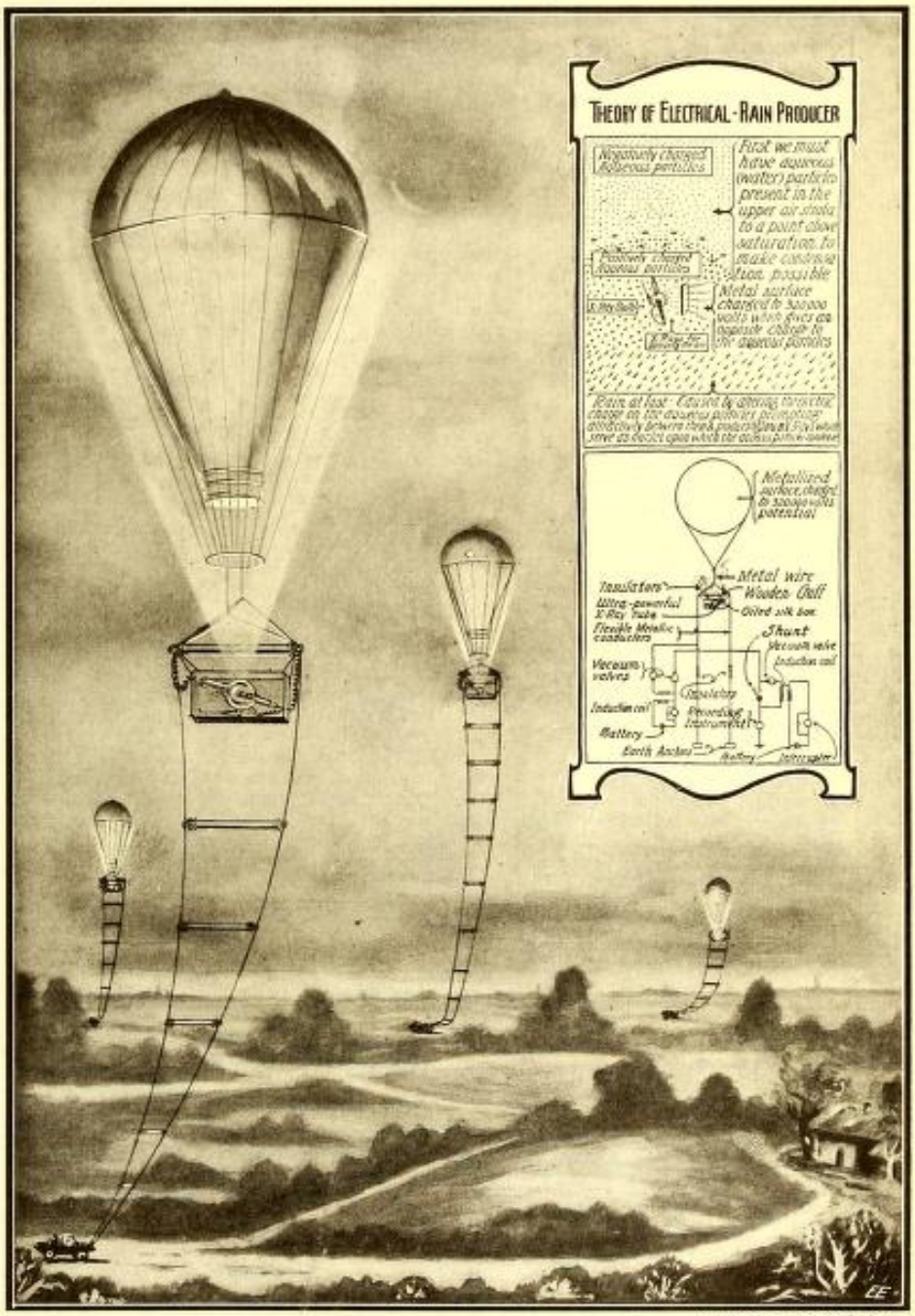
It has been ascertained that ions, produced in this case by Mr. Balsillie by the powerful X-rays, which ionize the atmosphere in the vicinity of the balloon, may act as nuclei, upon which, under certain conditions, water vapor will condense. Aqueous particles comprising cloud, fog or mist are invariably electrified by natural causes, and altho their electrification is of one sign, the potential or voltage distribution thruout the mass is uneven. Aqueous particles of approximately equal dimensions and potential will therefore naturally repel each other, and no condensation will result. However, nuclei, upon which water condensation may take place, can be created by ionizing the atmosphere, such as by powerful X-rays, and further if under normal conditions, a *mutual repulsivity* of charge of the aqueous particles is altered to a condition of *mutual attractivity*, then coalescence of such aqueous particles will be assisted, and rain caused to fall.

As the accompanying detail illustration shows, if a metal plate (or the metallized surface of the balloon) is charged at a very high potential of say several hundred thousand volts, then this electrified body serves to give an opposite charge to the aqueous particles floating in the atmosphere.

The aqueous particles thus become possest of a charge of *opposite sign* to that which they originally had. This charge of opposite sign, however, is not and cannot be communicated instantaneously to all the particles in said zone. The particles in close proximity to the source of electrification are rapidly charged by electrostatic induction with a charge of opposite sign to that which they originally possest. This inversion of sign of charge is gradually communicated to all the particles in said zone in an ever-expanding circle, about the source of electrification as a center. At the perimeter of the circle of imprest electrification, at any instant, a condition exists whereby particles in close proximity to each other are possest of electrical charges of opposite sign. Such particles consequently attract each other, coalesce, and then fall as rain, under the influence of gravity.

The apparatus used for producing the high potential uni-directional current for charging the metallized balloon surface is produced by a transformer and interrupter supplied from a dynamo or other source on the ground. The secondary circuit of the induction coil is equipt with rectifying valves in order to rectify the current. Similar appratus, also provided with vacuum

(*Continued on page 749*)



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Man Is Slowly But Surely Learning the How and Why of Nature's Secrets. Rain and How It Forms Has Particularly Interested An Australian Scientist—John Graeme Balsillie, and His Method of Ionizing and Charging the Air Containing the Aqueous Particles Is Here Illustrated and Described. Ionization Is Accomplisht By Large X-Ray Bulbs Suspended From Balloons.

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Electrical Experimenter

H. GERNSBACK - EDITOR
H. W. SECOR - ASSOCIATE EDITOR

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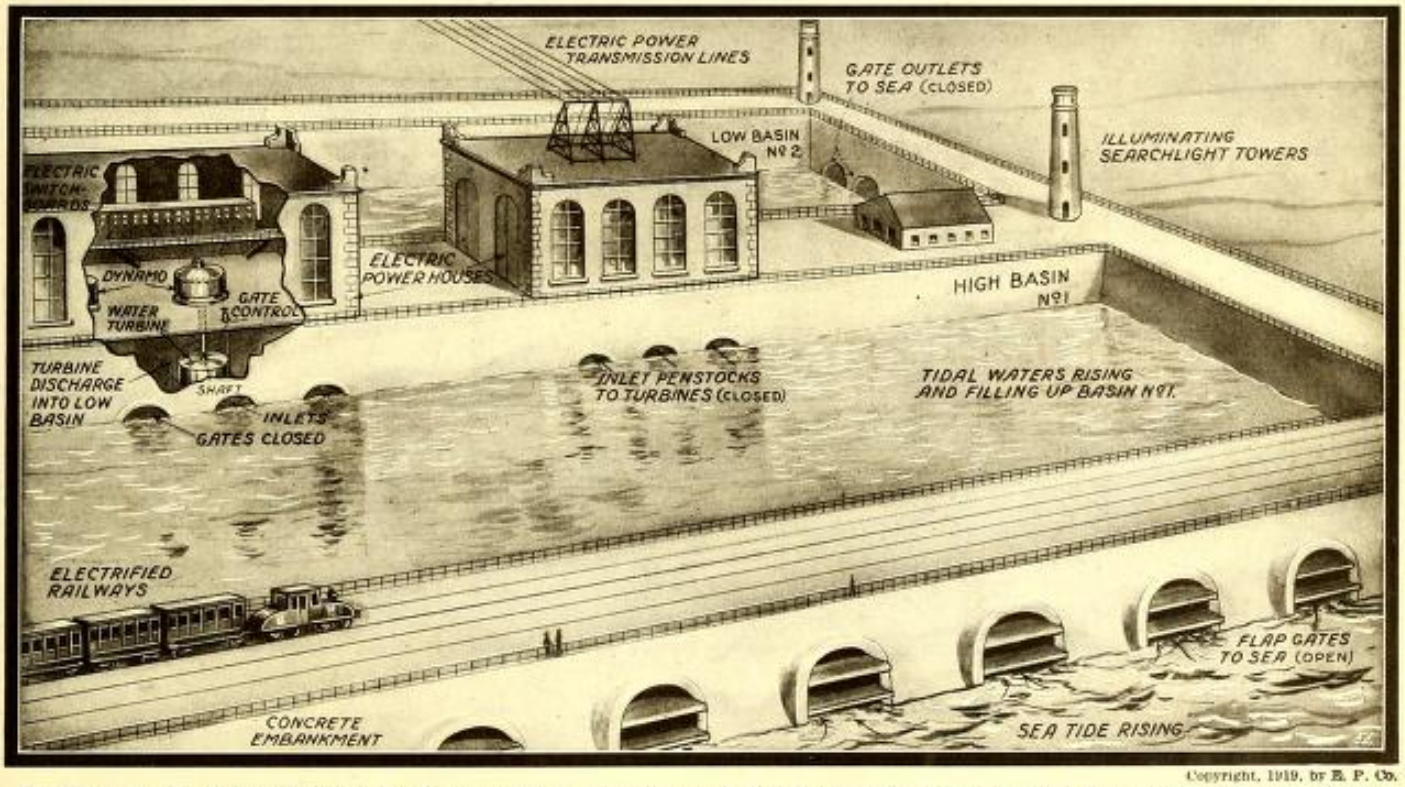
Tidal Power Problem Solved at Last

TIDAL power is one of those long dreamed of possibilities in engineering which has occupied the minds of great philosophers for generations. Why not,—for who can stand down by the ocean shore, or even by any large river having an appreciable tidal rise and fall, and fail to be imprest with the gigantic natural power here spread out before us, and let go to waste for all these years. Think of it—tens of thousands, yes, millions, of horse-power dissipating itself on our coastal and river shores every day in the year. To realize this fact fully we need but reflect for a moment. If the tide brings us a rise of several acres (many thousand cubic feet) of water, why let it fall again, *uselessly?* Allow the water to flow, without friction, into huge basins at high tide; trap it, and when the tide falls, permit the imprisoned water to escape, *but thru turbines*, back to the tidal level.

That is the idea several engineers have had, but an English engineer seems to have solved the problem successfully with his specially designed tidal turbines and triple basins. His name is J. O. Boving, and his scheme is so practical that it has been proposed for the development of electric power from the tide water at the mouth of the River Dee. Mr. Boving's description of the tidal power plant is as follows:

Altho the (English) Government a few months ago took a very wise and necessary step in appointing a committee to inquire into the possibilities of water power development in the British Isles, there is one aspect of the question which does not seem to have attracted adequate attention, and that is the utilization of *tidal power*. The rise and fall of the tides around the English coasts vary greatly, from a maximum of nearly *fifty feet* in some places on the west coast to only a few feet at others. Generally speaking, the differences on the east coast are small, but on the west coast there are many river estuaries and other inlets which offer abundant possibilities for obtaining power from the tides.

Some years ago I had an opportunity of examining the possibilities of developing a tidal water power on the estuary of the River Dee, where the tidal differences are roughly *thirty-five feet* at *highest* Spring tide and *thirteen feet* at *lowest* neap tide. The scheme put forward was to form a railway embankment across the mouth of the estuary so as to connect up the Welsh railway system with Birkenhead and Liverpool. The area of the impounded water behind this dam was to be *forty-four square miles*. On account of local conditions it was not difficult to divide this basin into two equal parts, and to arrange these two inner basins, the sea forming the third, in



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The Proposed River Dee Tidal Power Development As Designed By a Famous English Engineer—J. O. Boving. This View Shows His Two Basin Proposal Where the Area of the Impounded Water Would Amount To Forty-Four Square Miles. The Maximum Tidal Difference Is In This Case About Thirty-Five Feet. A Large Railway Embankment Is a Part of the Scheme, This Railway to Connect Up the Welsh Railway System With Birkenhead and Liverpool.

such a way that a power station could be worked *continuously* under constant head and with constant output. The plan was roughly as follows:

Supposing that we start with high tide, the flap gates leading from the sea to the high basin would be open, and the water would flow in and pass thru turbines into the lower basin, the automatic flap gates to this basin being closed by the water pressure outside. This flow would continue until the level in the sea equaled that in the high basin, when the flap valves to this would slowly close. *In the meantime the level in the high basin would slowly SINK as water was consumed, and the level in the low basin would INCREASE until the moment when the water level in the sea had fallen to such a point that the gates of the lower basin would open and discharge the water in it completely.* On the rising tide a similar sequence would be followed, and a continuous development of power would thus be maintained.

There are a great number of cases along the coast where it would be easy to create a reservoir at a considerable height adjacent to the tidal power station, or at least within a distance which would make electric transmission easy. In such cases the surplus power might be used during the periods when it is available for pumping up water to such reservoirs, while during the intervals, when power is required, it could be obtained thru high-pressure turbines driven by the stored-up water supplied.

It will perhaps be argued that this is a very elaborate and costly arrangement which would not pay. The problem in fact resolves itself to this: Assuming (1) that an ordinary water power in a river was developed and used for commercial purposes during twelve hours out of the twenty-four and that it was a good commercial scheme under these conditions; and (2) that a high pressure power development could be obtained by using stored water for twelve hours of the twenty-four, and that this also was a commercially good undertaking in itself; then it must be equally sound commercially to link the two together and produce power around the twenty-four hours. In the tidal scheme the only things added to the arrangement described above are pumps, which are a negligible factor in the general costs (they would correspond to something like $3.75 per h. p.). The pipes thru which the water is pumped up are, of course, the same as those which return the water from the high pressure plant. Everything else is in common.

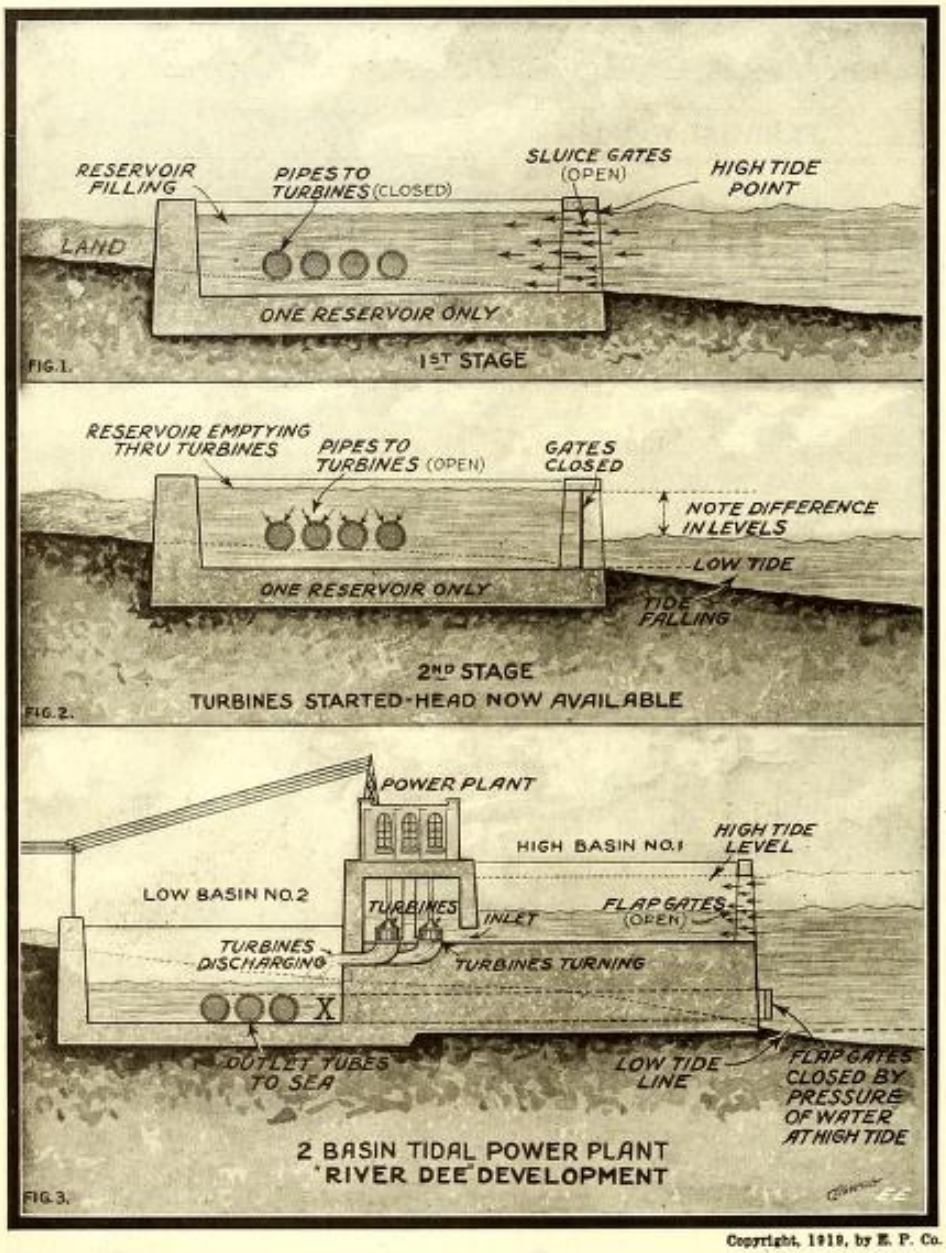
The calculation for such a scheme is simple, and in the case referred to, assuming that in any case a bank was needed across the Dee mouth, for railway purposes, there is no doubt that this power development would pay well. In cases where two tidal plants of similar size are close together the necessary conditions could be realized by connecting them. There would be nothing novel in such plans; the turbines would be of standard design, the variation in the head would be only such as would be allowable for in ordinary turbine plants, and there would be no need to bridge over any periods when the power developed fell much below the average power.

However, in most cases it would be impossible to develop the three-basin idea, and it would be necessary to rely only on one inner reservoir and the sea. Obviously under such conditions the engineer has to contend with very great variations in head and power. The great differences that occur in the tidal ranges at various times compel him to calculate his turbines for the average head derived from neap tides.

The general idea of a one-reservoir tidal scheme is as follows: At the beginning of high tide the sluices are open fully and the water rushes into the inner reservoir, filling it up as quickly as possible. Then the gates are shut for a certain time, *until the water level outside has fallen to give a desired difference in level between the reservoir and the sea.* (See detailed illustration of one reservoir scheme herewith.) The turbines are now started and kept in operation under virtually constant head, while the level in the reservoir falls at the same time as the tide. Some time before the lowest level of the tide the turbines are shut off, the gates opened, and the remaining water in the reservoir allowed to rush out with the lowest tide. Then the gates are closed, the tide rises outside until the difference in level between the sea and the reservoir has again reached the agreed amount, the turbines are started, and the same procedure is gone thru for the rising tide as just described for the falling. Thus for certain definite periods power is obtained at a nearly constant rate, but in the intervals no power is produced.

Up until now we have been satisfied to mine and burn coal, prospect for oil gushers, and, in fact, have tried out about every expensive source of power we could think of. This comes of prosperity. America is rich, and the keynote of the hour is "speed." Design, develop, build,—do all these things—say our great philosophers and educators, but do them FAST. Speed is a fine thing—in its place; but there is bound to be a big bill to pay, some day. Why not live and work efficiently; not necessarily in a slow, plodding, unenlightened way, but in an economical manner. Coal and oil will not last forever. If you have ever visited Holland, you have undoubtedly been imprest with the simplicity of things, and those windmills. There is a fine bit of antique engineering. The Hollander is using an untaxable, free, and powerful source of natural power—the wind. Besides these you will find in all parts of Europe the ever-present water wheel and turbine. Excellent, steady power, untaxed in most cases; but do the American farmers and developers put the *free* wind and water power to work? Yes, they do NOT. They would rather spend a thousand dollars or so for a gasoline engine and then work their heads off for the rest of their lives buying gasoline and oil to run it with. You can see hundreds of windmills and waterwheels rusting to pieces all over the country. A great pity and a prodigious waste.

Sweden, which is rich in water power, sends electricity across the sound to Denmark.



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Progressive Illustration Showing How the Tidal Power Plant Works. First Figure Shows How the Rising Tide Fills the Large Basin Or Reservoir With Water. At Full Tide the Sea Gates Are Closed and After the Tide Has Fallen a Few Feet, a Working "Head" Becomes Available As Fig. 2 Shows. The Impounded Water Discharges Thru Turbines Back to the Sea. Fig. 3 Shows a "Two Basin" Plant Which Discharges the Impounded Water In Two Stages, Giving Steadier Power Development.

New York to Chicago Via the Air in Twelve Hours

"AIRLINE TICKET for Chicago, Please." "Yes, sir; five hundred and twenty dollars, Please. The next 'liner' leaves in half an hour for Chicago and way stations," replied the ticket agent of the *Trans-Continental Airline Company* on a bright June morning in the year 1919. At least that is a fair sample of the conversation we may find quite common in a few months or so, if the plans of one of the largest aërial transportation organizations materialize in any such manner as their originators predict. Complete arrangements for the construction and operation of a line of passenger carrying dirigibles between New York and Chicago at an initial charge of sixty-five cents a mile for each passenger have been made by J. M. McElroy, chief engineer of the Sturtevant Aeroplane Company, of Boston, in collaboration with Noble Foss, one of the officials of the corporation and a son of former Governor Foss, of Massachusetts.

Announcement of the big undertaking was made recently by the Massachusetts Aircraft Association, which held its annual aeronautical exposition at Madison Square Garden and the Sixty-ninth Regiment Armory from March 1 to 15, inclusive, in cooperation with the War and Navy Departments.

It is proposed to form a company with four dirigibles and two main terminals, one at New York, the other at Chicago. The dirigibles are to be of the Zeppelin type, with rigid housing and multiple compartment structure. The U. S. War Department's wonderful new discovery, Helium gas, will be used, thus removing the danger of fire. The airship will be 425 feet in length and forty-five feet in diameter. Its engines will have a horsepower of 1,200. The bag will have a capacity of 650,000 cubic feet of gas, providing a gross lifting power of twenty tons at sea level. This would mean a practical net lift of ten tons.

It is estimated by Mr. McElroy that a speed of seventy miles an hour can be maintained and that the trip from New York to Chicago could be made in comfort in less than twelve hours.

"The cost per mile, roughly speaking," says Mr. McElroy, "would approach sixty-five cents per passenger, or $520 for the entire trip in either direction. There is no doubt but that after the line is run for some time, it will be possible to cut down the rate considerably."

Each dirigible will have accommodations for twenty-five passengers. The power plant will consist of two engines, side by side, driving thru gears a central stub shaft mounting a variable pitch air screw. Balance and altitude will be adjusted by expansion or compression of the gas.

The crew will consist of the captain, navigator, chief and two assistant engineers, wireless operators, steward, cook, waiter and maid.

In regard to the landing places, which with dirigibles is a great problem, Mr. McElroy says:

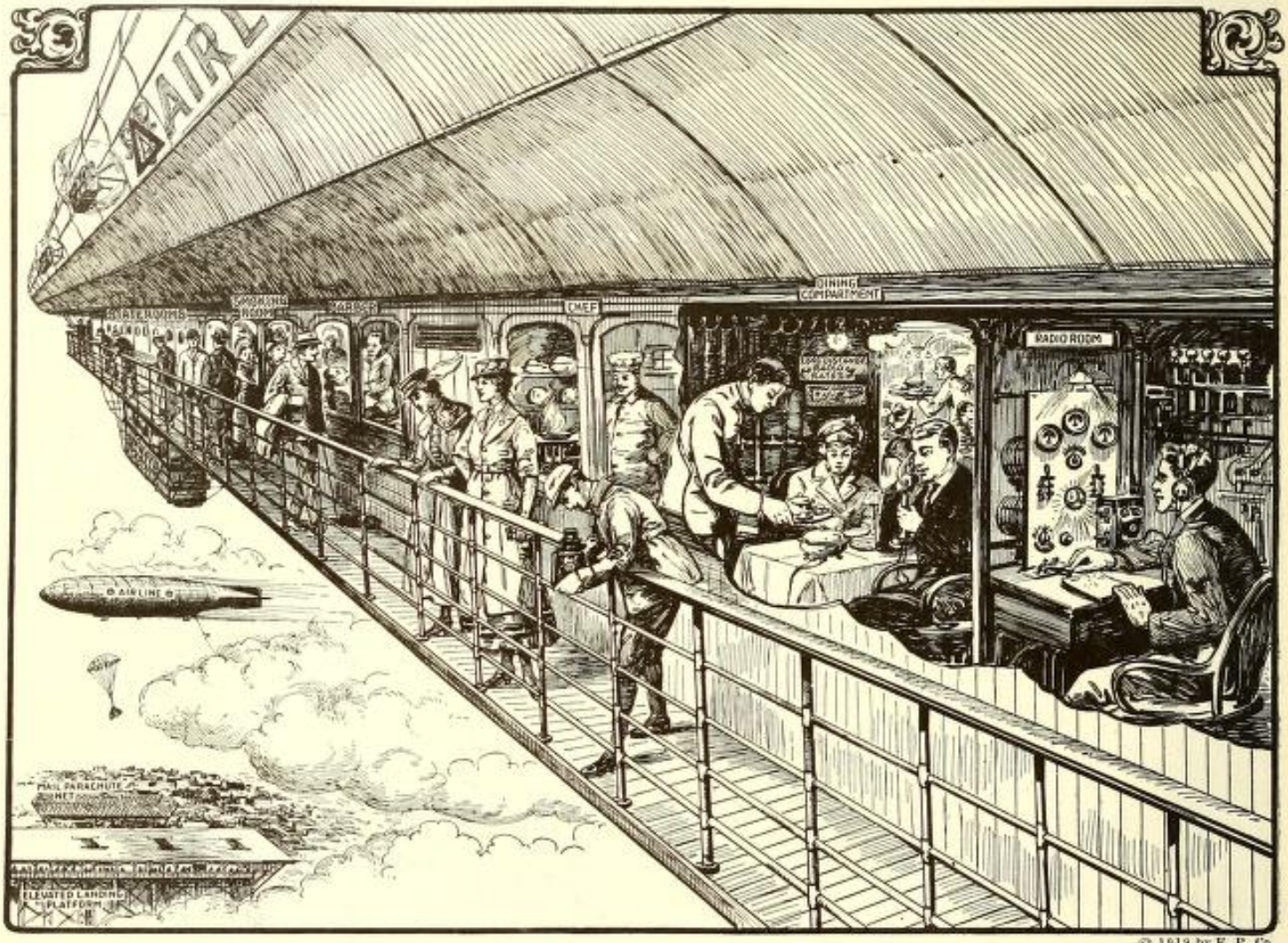
"It is reasonable to believe that hill walled landing zones could be located, or natural depressions in the earth could be enlarged to offer breakairs to permit the air liner to come down safely. The terminals at either end of the New York-Chicago route could be floating piers secured at one end, so as to swing with the wind to permit easy housing of the ship."

With regard to the possibility of trans-Atlantic flight, Mr. McElroy says:

"When we have put the New York-Chicago route into successful operation then it is time to throw a line across the pond and do a real job."

Apropos of transcontinental aërial transportation we find much food for thought in a speech recently made by Allan R. Hawley, president of the Aero Club of America, before the National Rivers and Harbors Congress, at Washington, D. C., on

(*Continued on page* 915)



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Regular Air Line Passenger and Freight Transportation Between the Larger Cities, Particularly New York and Chicago, Promises to Become an Accomplisht Fact This Spring. A Company Has Already Been Formed to Develop and Promote This Project. All the Usual Conveniences Will Be Available to Passengers, Besides Wireless Communication, Mail Service, Sleeping Quarters and Aerial Promenade, Not to Mention the Most Wonderful Scenery ever Presented to Alpine Tourists, for These Giant Airships Will Fly Right over the Mountains.

Guiding Airships With the "Radio Barrage"

Invisible Walls of the Ether

By DR. LEE de FOREST

JUST at this time, when our army and navy officials, and many airplane builders, are taking steps for the commercial development of the airplane and dirigible, along industrial and governmental lines, is it not practicable, as well as advisable for radio inventors and engineers, as well as others concerned, to give thought to those essential safety devices which come within the scope of radio-communication and control?

I venture to say that if there was any one device used in the European war which contributed to the success of the Allies in their supremacy of the air, it was radio-communication, both telephone and telegraph. By means of it the fighters in the air were at all times able to talk and signal with their commanding officers at headquarters, and after a personal examination of the various kinds of apparatus used by the different countries, all of which pay high tribute to American genius, I feel I am fully justified in predicting an even greater use of radio control and communication for peace purposes.

One of the first questions to be taken up, it seems to me, when we have reached the point of regular passenger and freight traffic by air, is that of proper warning to pilots in case of fog, cloud or other interferences. Will it not be necessary, for example, to establish a regular "traffic squad of the air," for those cities in the principal lines of communication? The use of the human voice in sounding a warning, without wires, is already an accomplished fact; at Point Judith Light, where the *Radiophore*, at regular intervals, calls out to the ship operator: "Point Judith Light," and then in a weaker voice: "You are getting closer—Keep off."

By means of a number of wireless stations placed around any given city, why cannot we do likewise in the matter of our radio traffic squad of the air? So that when a pilot comes within range, he would receive a message such as the following:

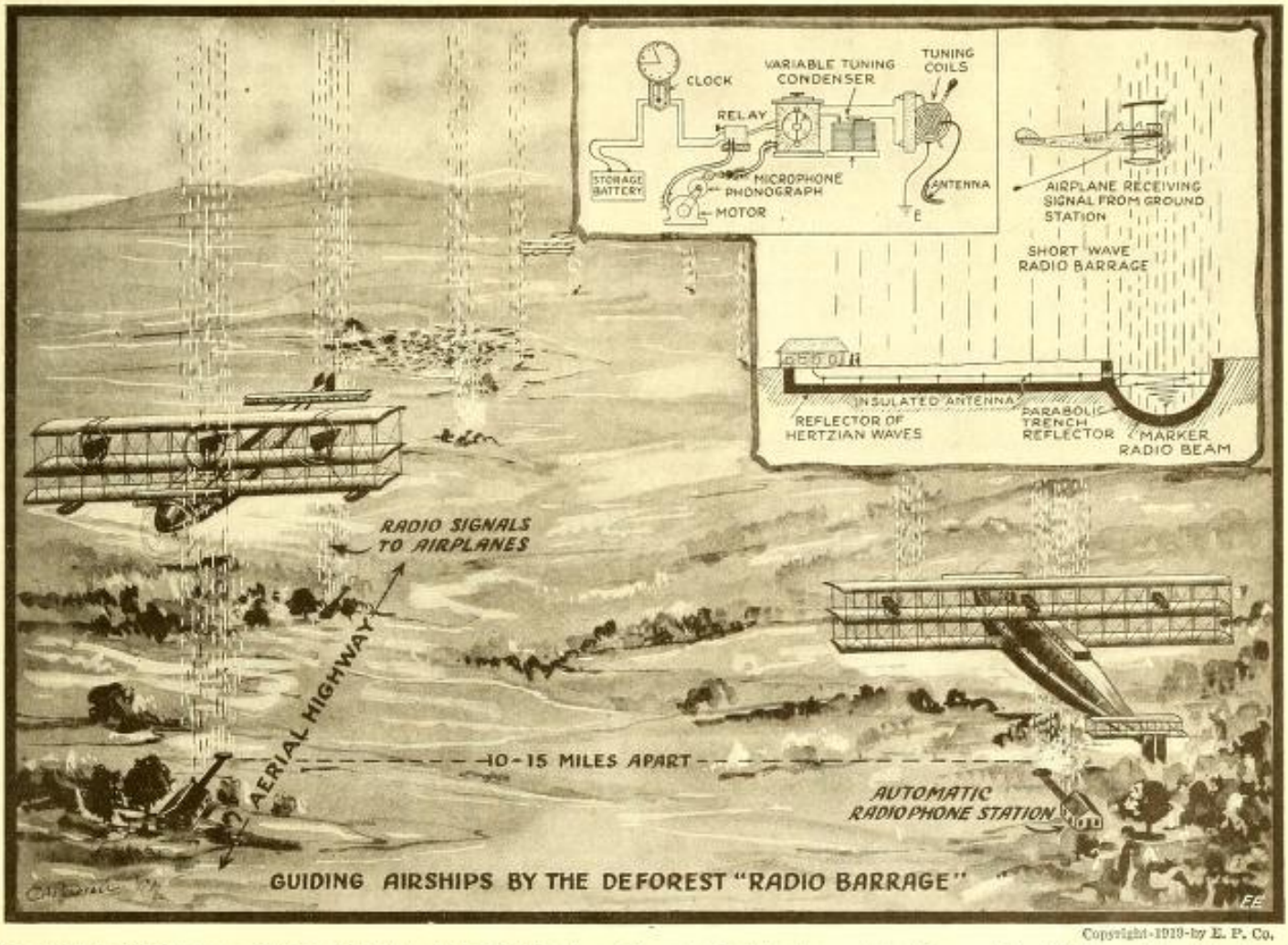
"Buffalo Office—Turn West by South, and Pick up Cleveland," or again such warnings as, for example, it will be necessary to inform the pilot of weather changes: "Weather Warning—Your are nearing a storm area—Cyclone Ahead," etc., etc.

There should be, no doubt, a continual "radio barrage," or zone of automatic warnings thru which airplanes must pass in approaching regions where air traffic is dense; namely, around landing stations, and especially so near steep mountain ranges and peaks, or cities like New York, with extraordinarily tall buildings with consequent air pockets.

By arrangement of antenna or reflectors not unlike those used behind large searchlights, a beam, or narrow zone of wireless waves, invisible to the eye of course, could be set up. This would necessitate the use of very short wave lengths, of only a few meters, far shorter than the wave lengths used today in radio-communication. This feature would also have the advantage that these short wave lengths would not interfere at all with existing radio-communication. All this short wave vertical radiation would be controlled by the automatically repeating phonograph, similar to the *Radiophore* arrangement at Point Judith Light.

The pilot of the airplane, his 'phone clamped to his head in the helmet, would hear these safety signals as he flies thru these invisible walls of etheric warning, in ample time to govern his course accordingly.

With the mastery of the air for governmental, and for commercial purposes, already at hand, certainly the question of radio control, and of traffic regulation, is of prime importance, worthy of the immediate interest, and of the best thought in the radio world.



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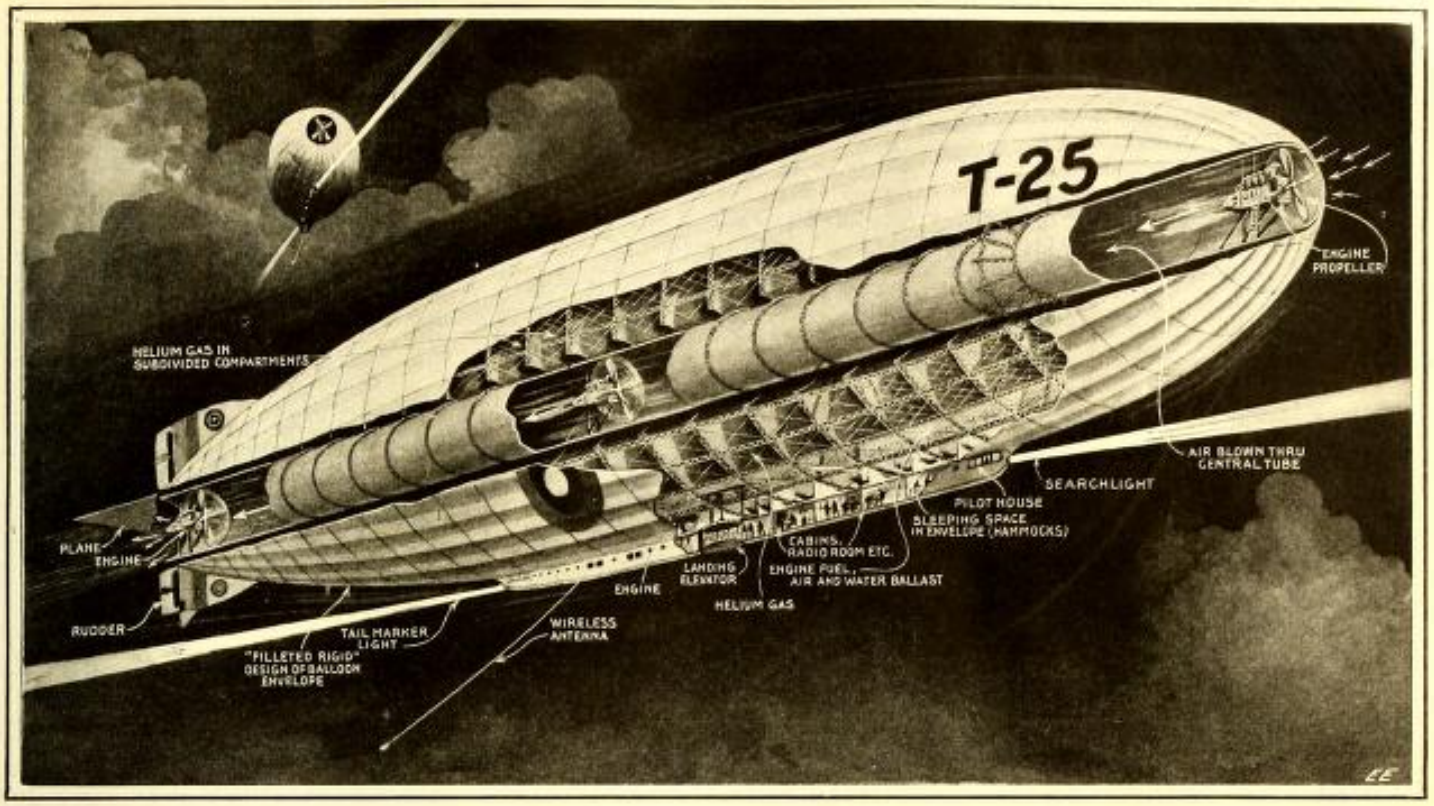
The Airships of Tomorrow Will be Guided by Wireless Telephone Signals, Possibly Arranged in "Barrages" or Walls, as Here Illustrated. This is the Only Feasible Way of Signaling Location and Weather Data to Aërial Craft in Stormy and Especially Foggy Weather. Prof. Walter I. Schlichter, of Columbia University, Has Also Recently Advocated the Use of Powerful Wireless Signaling Stations for Guiding Trans-Atlantic Seaplanes in Their Proposed Trips Across the Ocean.



This Illustration Shows a Recent Development In Simplifying the Airship and at the Same Time Making for More Efficiency all Around. The Idea Is To Do Away Entirely With the Underslung Power Gondolas, Such as are Used on the English and German Airships of the Zeppelin Type. The Engines are Housed in a Wind Tunnel Running Thru the Center of the Airship as Shown. Propellers Which are from Fifteen to Twenty Feet in Diameter Create a Sort of Vacuum Within the Tube, and the Airship Therefore will Virtually Suck Its Way Thru the Air at an Increased Speed.

Speeding Up the Airship

By H. GERNSBACK

ON its historic cruise to the United States the R-34, while making a splendid achievement, disappointed many for the reason that it had been hoped that the dirigible would make a westerly passage much quicker than it actually did. Of course, the airship had to battle against head-winds nearly all the way over, which is best proven by the fact that on its return trip it accomplisht ,the eastward passage in 75 hours.

One reason, and the entire reason, that Brown and Alcock flew across the ocean in sixteen hours with an airplane, while the quickest trip of the airship took over four times as long, is explained in one word—friction. The airplane offers but little surface to the wind, due to the fact that its surfaces not only are comparatively small, but cutting like a knife, they do not offer much resistance to the air. The airship on the other hand, due to its large and cumbersome bulk, gives rise to enormous friction not only head on, but along its sides as well. In this capacity it stands on a par with the big ocean liner that sinks deep into the water, and consequently needs an enormous power to move it, whereas the little motorboat-hydroplane, when provided with suitable vanes, will actually skim above the water, hardly touching the latter, at a speed many times that of the ocean liner. Here we have the same comparison. It is simply a matter of reduced friction of the mechanical birds and their natural element, the air. We therefore find that if we can do away with all unnecessary friction on the huge airship, we will be able to propel it much faster. Take the case of the R-34 with its four gondolas; these take up quite a good deal of room and make for air resistance when the airship is in flight. While to the layman this appears trifling, it tends to retard the total speed of the airship very considerably, and if we can do away with these gondolas and their engines, we will increase the speed of the airship by just so much.

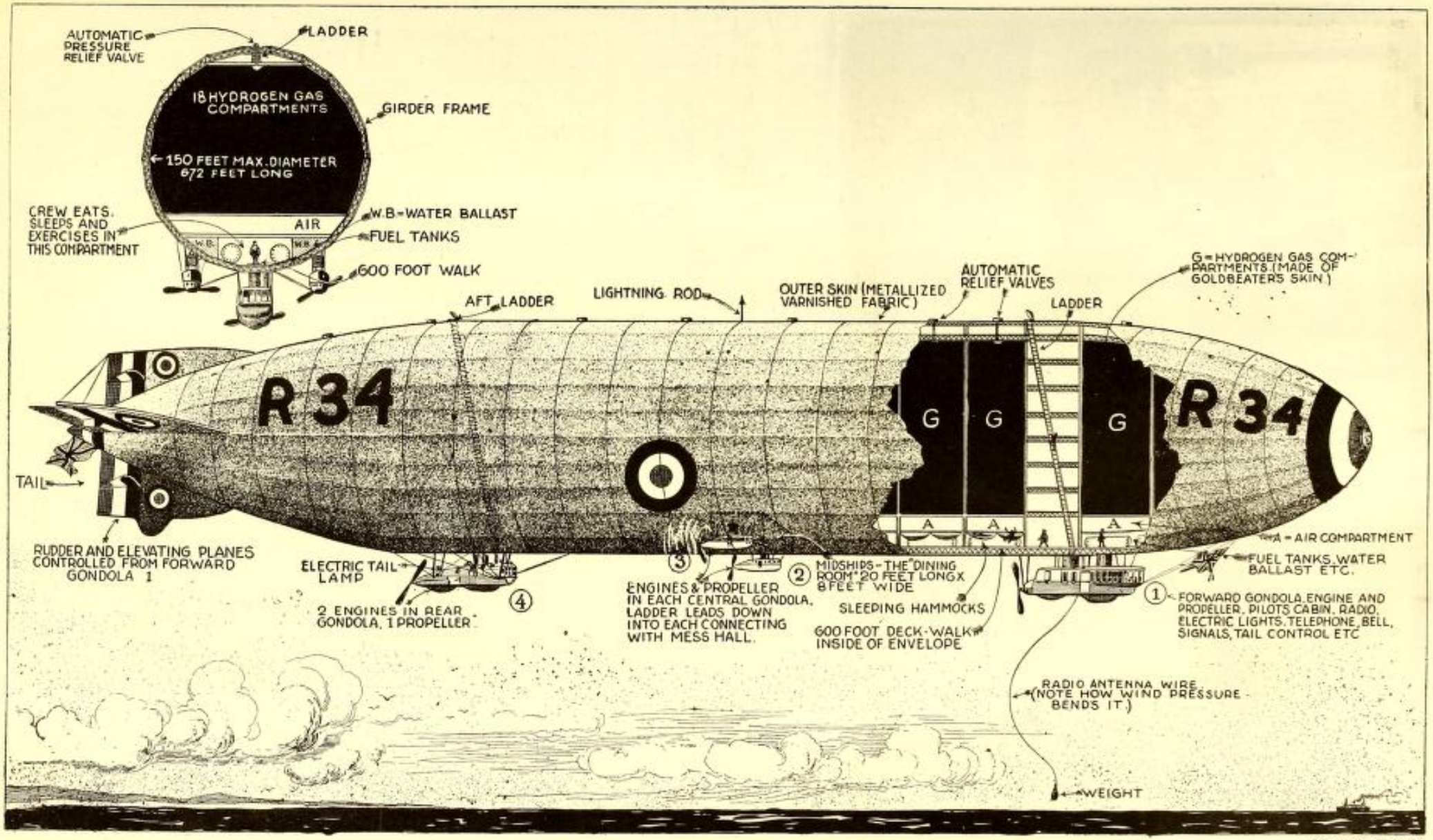
Also, if we can diminish the resistance created by the nose of the airship as it plows its way thru the air, we will again increase its speed. This, of course, is apparent, and the following experiment, which anyone may try himself, ought to prove it abundantly. Take a pail of water and try to drag it with the open side thru a stream of water. You will meet with an enormous resistance. Take the same pail and make a hole of about half the diameter in the bottom of the pail. You will now find that you can drag the pail with considerable ease, for the reason that the water flows right thru it. In the former experiment it was necessary to first fill the pail with water, and after this move (displace) a column of water represented by the diameter of the pail.

With these things in view, the writer offers a novel idea in which it is proposed to speed up dirigibles considerably. The idea is made clear in the accompanying illustration. It will be seen that this airship has no gondolas whatsoever, and the power plant is not hung underneath the airship, as is common in all Zeppelin types. Instead, the center of the airship is hollow, forming a wind tunnel extending clear thru the entire length of the airship. This air tube, of course, is not a small affair, but is anywhere from 15 to 25 feet in diameter, as will be noted. The three engines are stationed, the first at the nose, the second at the tail end, and the third in the center of the wind tunnel. The propellers must be of the same diameter as that of the tunnel, and the object is to have all three of them working at the same time in order to suck in the air at the nose of the ship and form a sort of vacuum. The air will then flow thru the tunnel, the same as the water flows thru the pail after we made a central opening in its bottom. From this it will be seen that the airship will *virtually suck its way thru the air*, and it should be possible for such a craft to make much greater speed than with the former methods. Moreover, as the engines are not exposed to the elements, it would also seem that not so much engine trouble should develop, as is the case with the under-slung type. Another very important consideration is that inasmuch as the air is rushing right back of the engines, the cooling of the latter is infinitely better than at present. And as every engine man knows, the better an engine is cooled the less likelihood there is of trouble developing.

In the aerial liner of the future, in order to do away with all unnecessary head resistance, the crew's quarters, etc., will probably be located at the bottom of the airship, and as will be noted in the illustration, the entire living quarters are fashioned with stream lines, to minimize all unnecessary air resistance.

Hydrogen gas will probably not be used much longer, as already Zeppelin types in Germany demonstrated that these huge bags are not safe with the enormous quantities of inflammable gas stored within their metallic girders. Electric sparks set up by the electrical machinery of wireless apparatus are a constant danger to the explosive gas, and the same is true should lightning hit the dirigible. The airship of the future for this reason will use Helium gas in its subdivided compartments, or some other

(*Continued on page* 446)



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THE "INSIDES" OF THE TRANS-OCEANIC AIRSHIP—THE R-34. THE FIRST DIRIGIBLE TO FLY ACROSS THE ATLANTIC

Imagine a gigantic airship resembling a huge sausage floating lazily thru the air over your head. This wonderful invention of man, measuring 672 feet in length, is nearly as high as the fifty-five story Woolworth Building in New York City, or three-quarters as high as the Eiffel Tower. The giant British airship, which successfully made the trip across the Atlantic Ocean from England to Mineola, L. I., N. Y., and return, was piloted by Major G. H. Scott and a crew of thirty men. On the trip over from England to America, her commander unconsciously carried a stowaway, a former mechanic who had worked on the ship in England, and who would not be cheated out of the first trans-Atlantic trip. The ship also carried a tabby cat as a mascot. The English Government has plans under way to build several new dirigible gas-filled airships similar to the R-34, but about twice its size. The R-34 carried approximately 2,000,000 cubic feet of gas. The accompanying illustration shows comprehensively some of the novel features in this first "Leviathan of the Air". The crew dined, slept and exercised in the long compartment running along the lower side of the gas envelope. The dining room is placed amidships, and is 20 feet long by 8 feet wide. All the four suspended gondolas carried propellers and petrol motors for operating them, and the members of the crew had access to any of the gondolas as occasion required, by means of covered ladders leading down from the 600-foot walk and passageway at the base of the gas envelope. The crew slept in hammocks suspended from the framework of the envelope, just above the 600-foot walk, as shown in the diagram. In rising from the ground at the start, ships of the R-34 class do not operate their engines, but simply throw off their mooring cables, when they rise rapidly to a considerable height.—8,000 to 9,000 feet elevation. The big ship then finds her natural "equilibrium" point, and the commander gives the order to start the engines and propellers. The giant blimp, termed a "filleted rigid" by her commander, Major G. H. Scott, then comes under perfect control. To cause the ship to descend, is simply a matter of shifting the water ballast and raising or lowering the horizontal tail rudders. The ship is kept on an even keel by vertical tail rudders. Astronomical observations, such as "shooting the sun" with a sextant, are carried on by one of the officers, who climbs up an 80-foot ladder to the top of the airship, there being two of these ladders, fore and aft. The range of the special wireless apparatus is remarkable, signals having been transmitted from the R-34, 1200 miles, from off the Azores to England. Signals from England and America were copied in mid-ocean. Four distinct wireless sets were carried, including one "wireless telephone" set. The Dirigible has a much greater lifting capacity than the NC planes, and can not only carry a higher powered radio set, but can support a longer antenna when desired.

Can Radio Ignite Balloons?

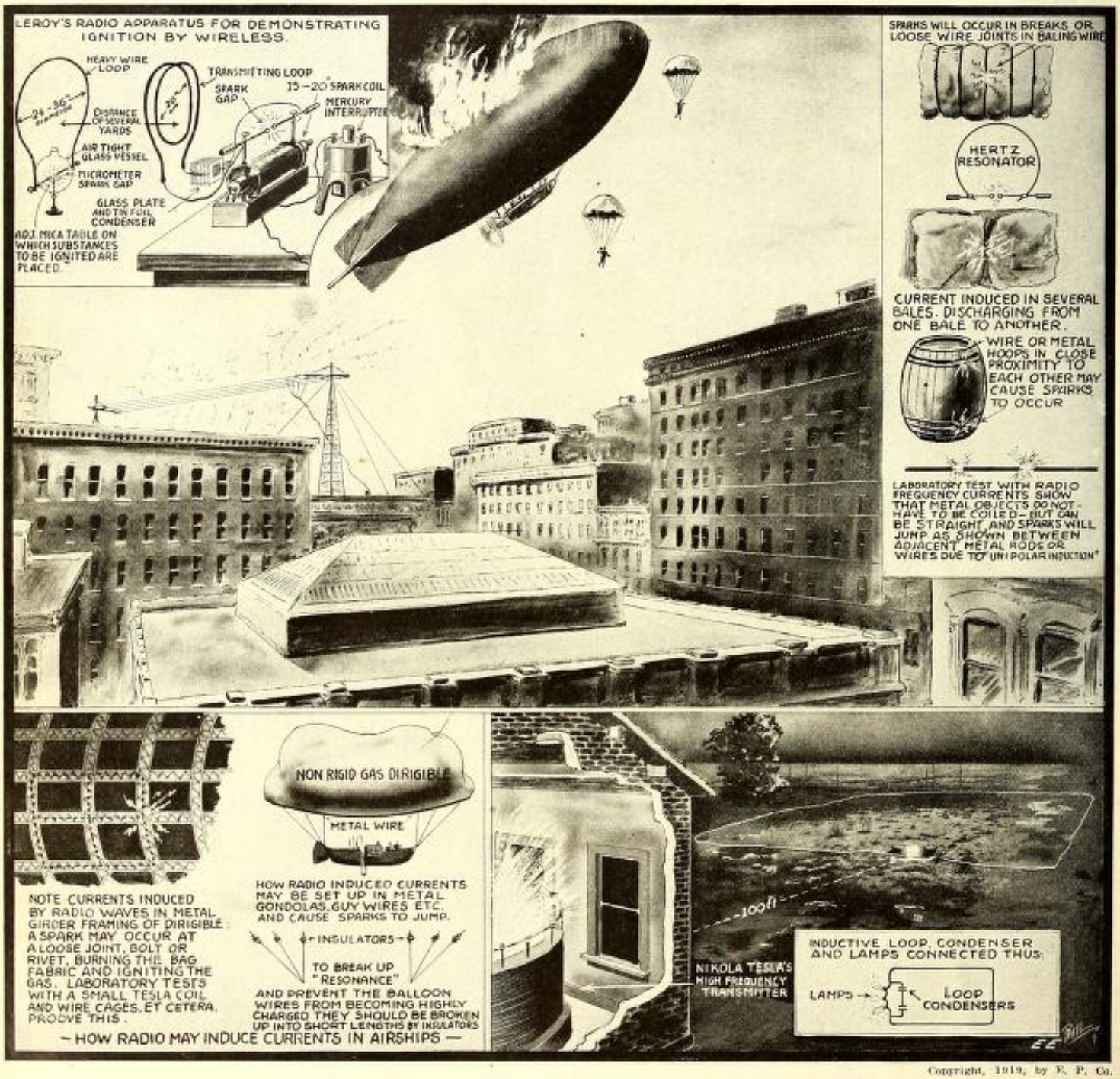
The Opinions of Nikola Tesla and Other Radio Experts

AS a result of the newest theory, that powerful induced currents emanating from the Naval Radio Station in Chicago produced the spark that ignited the Goodyear dirigible airship which plunged in flames thru the roof of a bank building in that city, resulting in death for thirteen persons and injury to twenty-seven others, naval communication officers will aid the authorities in fixing responsibility for the disaster. It was ascertained that technical experts had suggested *this* theory, because the big ship sailed over or near the Transportation building, from the roof of which are projected the antennae of the Naval Radio Station. The building thru the skylight of which the blazing dirigible fell was the Illinois Trust and Savings Bank.

Lieut. F. S. Mason, of the Great Lakes Naval Training Station, district communication service officer, while refraining from agreeing with the theory, said he would cooperate with the investigating officials. Pilot John Boettner, of the ill-fated dirigible, said he had not been aware of the location of the naval radio station. H. M. Byllesby, head of a large engineering corporation and foreman of the coroner's jury of technical men, said experts had suggested the *radio theory* to him.

Col. J. C. Morrow, chief air officer of the central department of the army, the principal witness at the inquest, was a passenger in the dirigible on a trip preceding the fatal one. At that time he said the ship was in safe condition. The pilot he considered competent. He thought the possibility of sparks from the exhaust igniting the gas bag very remote, but said he had not formed an opinion as to the cause of the accident.

(*Continued on page* 591)



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Herewith Are Shown Some of the Plausible Reasons Why the Recent Chicago "Blimp" Disaster Might Have Been Caused By a Spark Induced By An Adjacent Radio Station. The Photo In the Lower Right-hand Corner Shows Three Incandescent Lamps Lighted to Full Candlepower, At a Distance of 100 Feet from Dr. Nikola Tesla's Colorado High Frequency Power Plant. The Oscillator Was Worked At Less Than Five Per Cent of Its Total Capacity.

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VII. Whole No. 73 MAY, 1919 No. 1

VICTORIA
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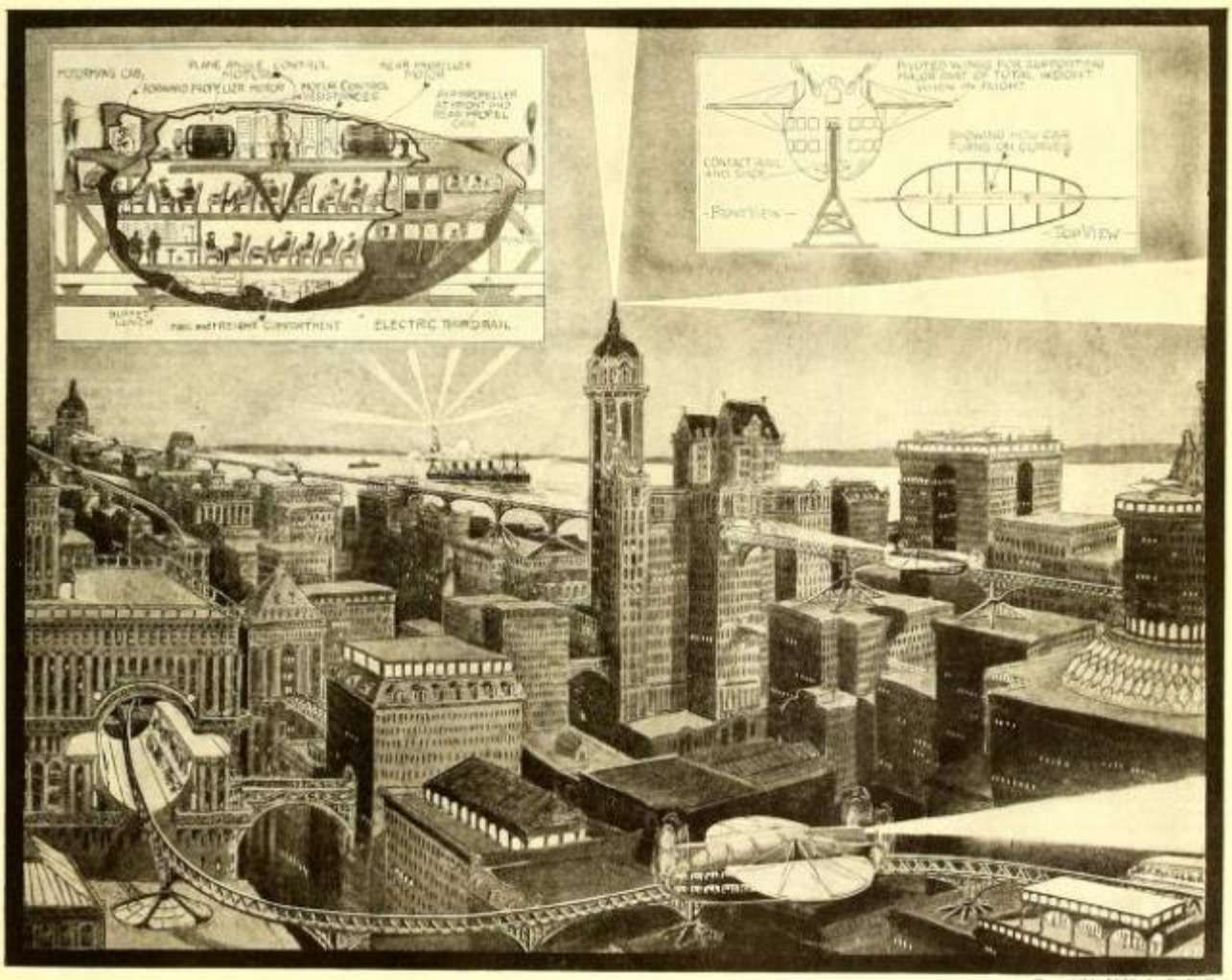
Future Rapid Transit

PEOPLE who have traveled abroad will remember having seen the remarkable suspended aerial railway of Elberfeld (Germany), the cars having wheels on the roof instead of underneath, and but one rail being used. This form of construction gives, among other considerations, much greater flexibility to the speeding cars or trains, as for example when they wish to turn sharp curves at comparatively high speed. Possibly many will remember having seen this interesting suspended railway in the motion picture travelogues given by Burton Holmes. It has always seemed to us, however, that these cars have a little too much freedom of movement to make the ride as comfortable as it might be to the passengers, owing to the constant swinging or sidewise rolling motion produced by this cradle suspension arrangement. Apparently there are other people who have entertained similar ideas, for in the accompanying illustration there is shown a new development of a monorail car, which might be termed an "Aërial Monoflier," and which has been recently invented and patented by the celebrated French engineer, M. Francis Laur of Paris. As M. Laur points out in his description of the invention, his scheme relates to an improvement in a vehicle for use in high speed locomotion in connection with a monorail or single track. A very novel idea of the project is a passenger-carrying vehicle somewhat in the form of

(*Continued on page 66*)



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The Aërial Monoflier of Tomorrow—Equipt with Wings, Like an Airplane, It Will Skim Along Thru the Air, Guided by the Monorail. The Cars Are Propelled by Motor-Driven Propellers, Which Derive Their Power from Third Rails, as the Car Glides Along at Speeds of 200 to 300 Miles Per Hour. When in Motion the Entire Weight Is Practically Carried by the Wings, the Same as in an Airplane.

Original MONEY-MAKING PLANS SEE PAGE 758

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October

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HUGO GERNSBACK
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NRA MEMBER U.S. WE DO OUR PART

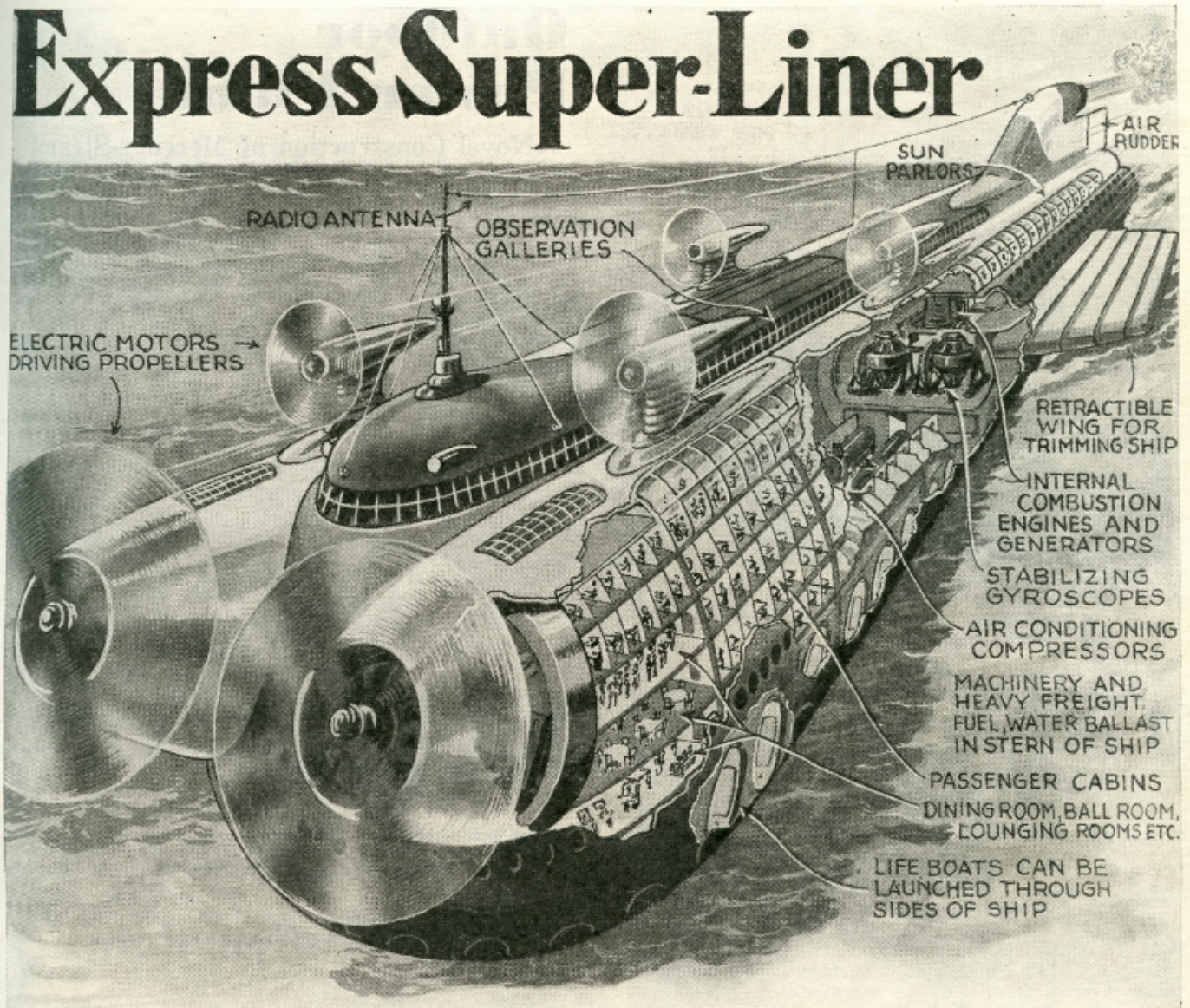
Super
Express Liner
Skims Ocean

See Page 737

PAUL

OCTOBER 1933

Express Super-Liner



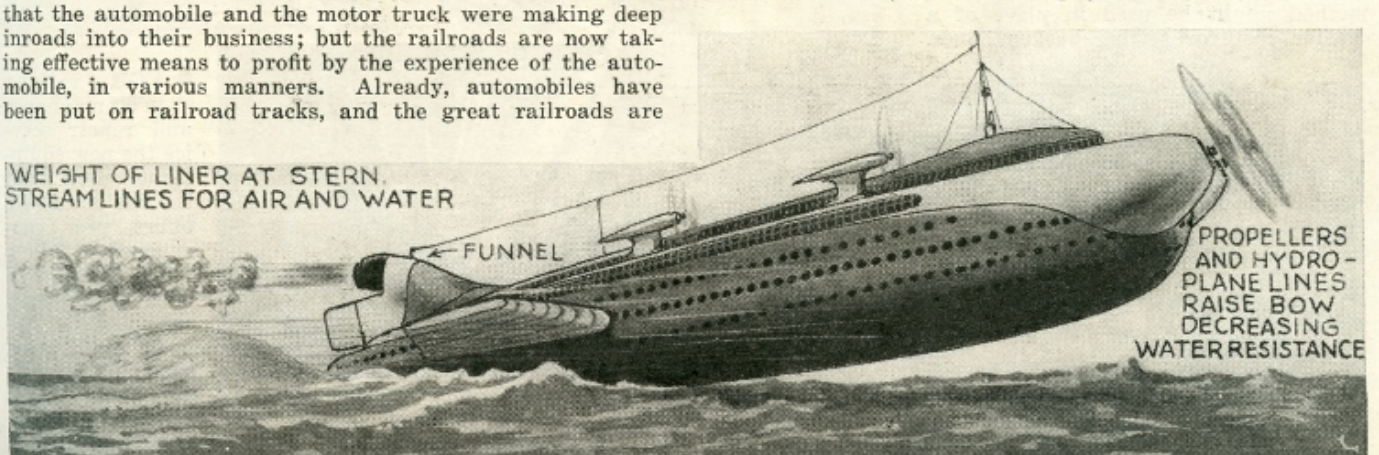
View of an express ocean liner of the future, in which the aquaplane principle is embodied. Its structure, though lighter than present ships, is heavier than an airship's: it will get up speed comparable to a Zeppelin's, skimming over the water, only a small part of which its hull touches. Thus we may have a day-and-a-half passage to Europe, or three-day to Asia.

Coming Inventions — No. 1

By HUGO GERNSBACK

● AS we all know, the automobile has not only revolutionized traffic on the roads, but has directly affected the railroad as well. Almost too late did the railroads realize that the automobile and the motor truck were making deep inroads into their business; but the railroads are now taking effective means to profit by the experience of the automobile, in various manners. Already, automobiles have been put on railroad tracks, and the great railroads are acquiring fleets of motor trucks to compete with the independent trucking industry.

(Continued on page 779)



It may be possible to supplement the air propellers by a method of driving at the stern, so that the rear of the ship will run *on* water, not *in* it.

Original MONEY-MAKING PLANS SEE PAGE 618

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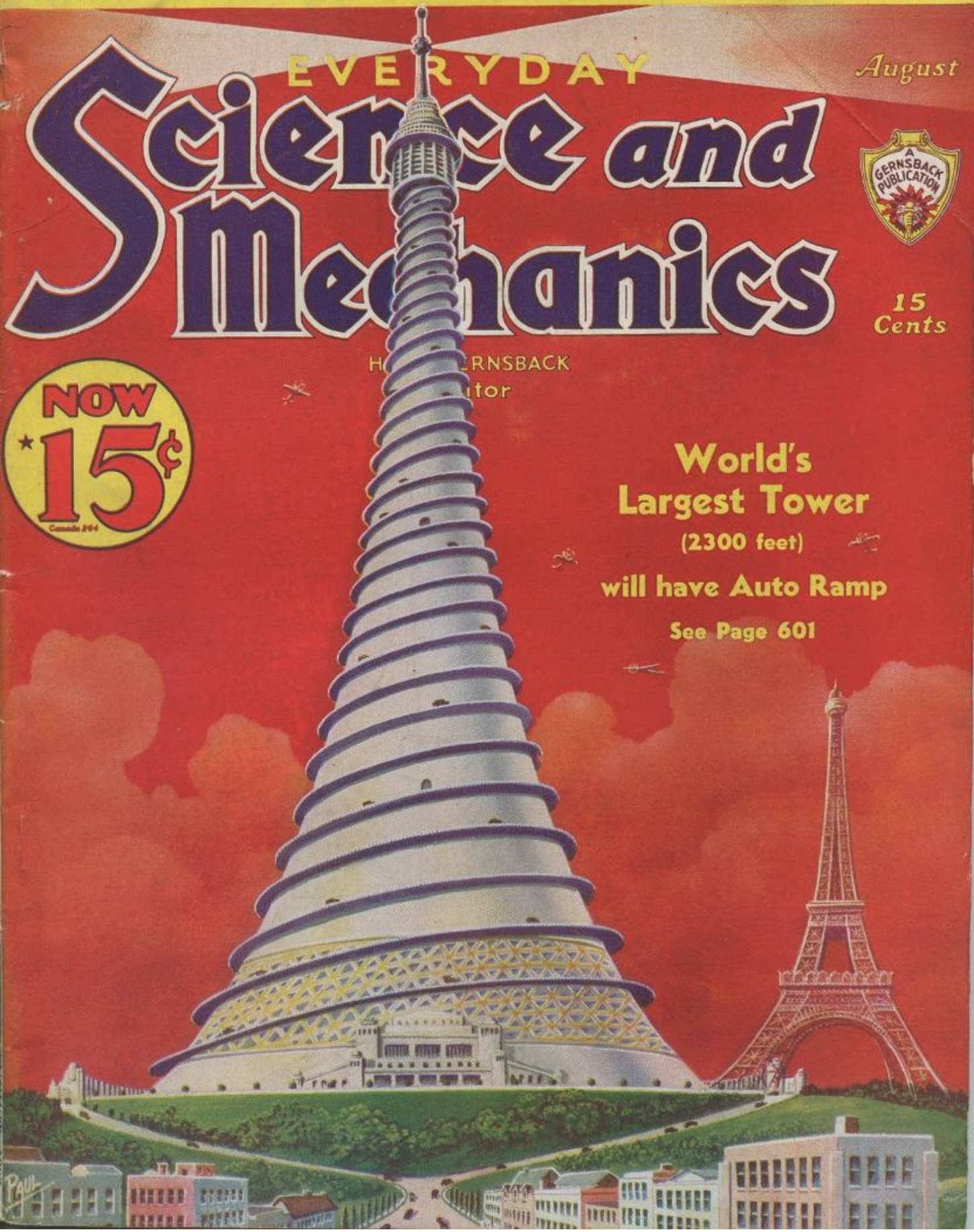


World's Largest Tower

(2300 feet)

will have Auto Ramp

See Page 601

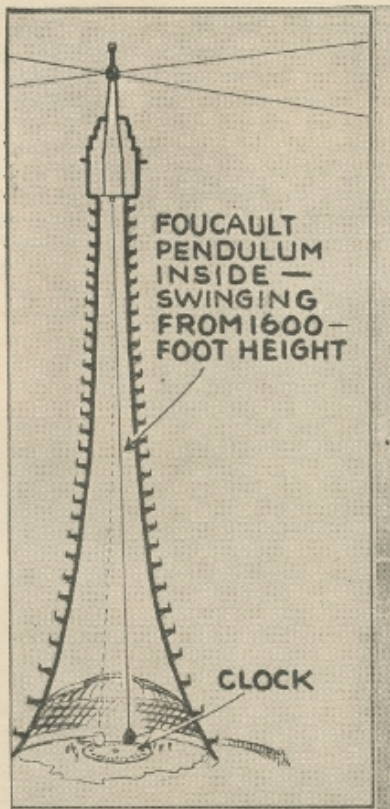
Cars will Drive Up 2300-Foot Tower

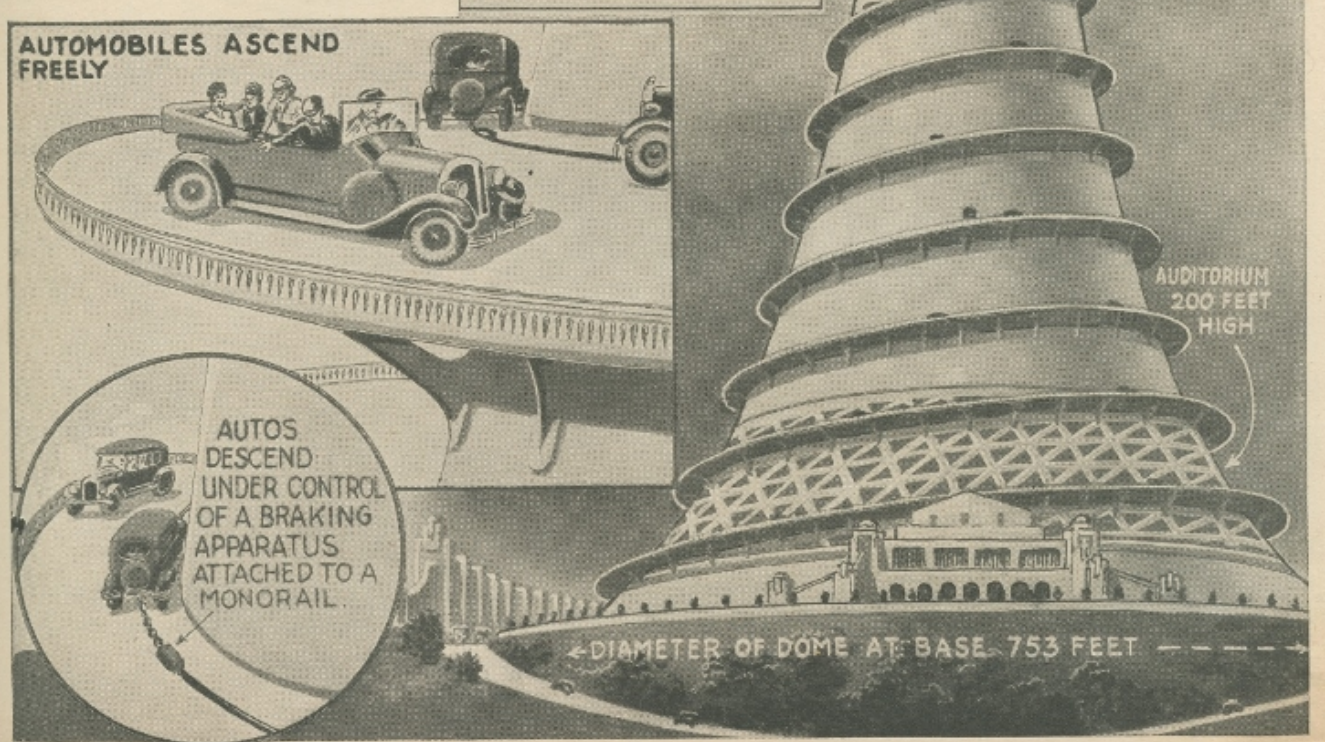
World's Highest Structure to have Spiral Ramp for Motoring Above Clouds

● "LIGHTHOUSE of the World" is the name its designers have given this record-breaking structure, which is to dwarf the Empire State tower by more than a thousand feet, and to look down from more than a quarter of a mile of superior height on its predecessor of half a century ago, the Eiffel Tower. It is, in fact, higher than these two, one mounted on the other. For the Paris World's Fair of 1937, this will be the most conspicuous feature of the landscape, dominating that city, even though miles from its center, and casting its beams by night as far as Belgium and England.

There are two structural novelties in this stupendous shaft. First, it is integrally of reenforced concrete, without internal bracings, and tapering in a curve to a height of 1,600 feet. This "exterior skeleton" will be self-supported and braced against wind pressure in all directions. Spiralling around its exterior is a

(Continued on page 641)





EVERYDAY

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Sept.

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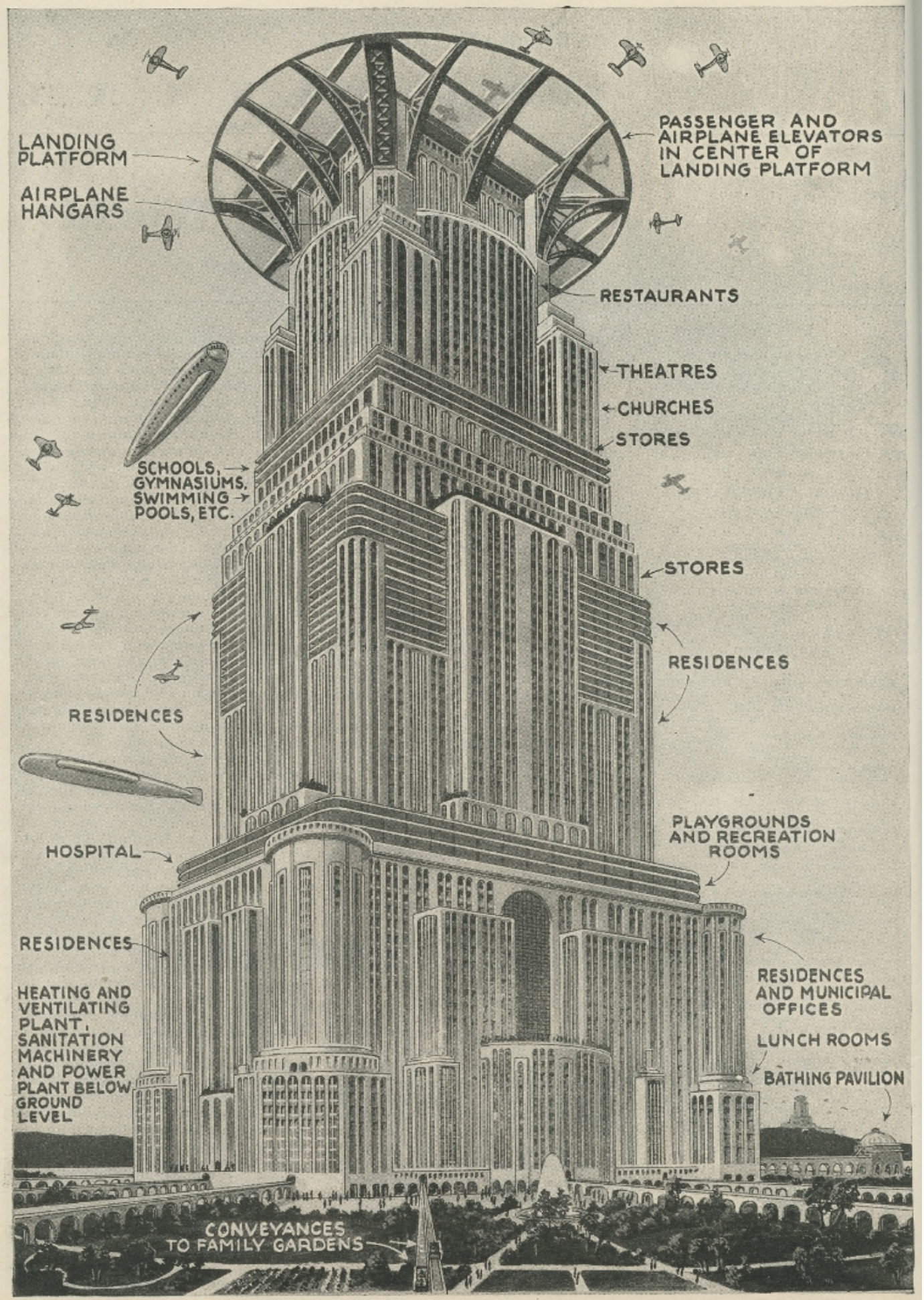
Editor

100 YEARS HENCE

See Page 910

PAUL

LATEST INVENTIONS, AERO-MECHANICS, SHOP KINKS, TELEVISION, EXPERIMENTS
FORMULAS, CHEMISTRY, WOOD AND METAL CRAFTS; RADIO KINKS


LANDING PLATFORM
AIRPLANE HANGARS
PASSENGER AND AIRPLANE ELEVATORS IN CENTER OF LANDING PLATFORM
RESTAURANTS
THEATRES
CHURCHES
STORES
SCHOOLS, GYMNASIUMS, SWIMMING POOLS, ETC.
STORES
RESIDENCES
RESIDENCES
PLAYGROUNDS AND RECREATION ROOMS
HOSPITAL
RESIDENCES
RESIDENCES AND MUNICIPAL OFFICES
LUNCH ROOMS
BATHING PAVILION
HEATING AND VENTILATING PLANT, SANITATION MACHINERY AND POWER PLANT BELOW GROUND LEVEL
CONVEYANCES TO FAMILY GARDENS

100 YEARS HENCE

BY HUGO GERNSBACK

● IF THE past one hundred years are a criterion of what will happen during the next one hundred years, it would be safe to say that in 2032—if you were to live that long—you probably could not recognize the present world, due to the titanic changes that are sure to take place.

Great social as well as other evolutions are going on quietly all over the world, and the so-called Machine Age has worked tremendous changes in even the past ten years. There is no reason for supposing that the process is suddenly going to stop, although that, of course, is not impossible. If we are to follow the warnings of history, we must come to the conclusion that high civilization is often followed by extraordinary debasement. Witness the high culture of the Egyptians 5,000 years ago, and also that of the Romans 2,000 years ago, and the barbarism that came after the downfall of these nations.

That humanity will be faced with such downfalls in the future can hardly be denied. The question is, when is the next cataclysm to come? Let us assume, however, that during the next one hundred years progress is going to go on at the same rate as it has during the past one hundred years; what, then, will the world look like in 2032?

It is certain that two things will happen; one, the cities will keep on growing—perhaps in the same ratio that they have grown, and perhaps a greater—but in a different direction than during the past one hundred years. Already, it is evident that the large city is not a place for the worker to dwell in peace; the exodus to the suburbs has clearly pointed that way. Cities like New York, Chicago, Philadelphia, etc., at the end of one hundred years will be tremendous bee-hives, but they will be almost entirely workshops and offices. Much manufacturing of the lighter kind, clerical and all other work will be done in the city. Quick transportation by air or subway will bring the population to and fro twice a day, much as we have it today; with the difference that the distances traveled by individuals will be five to ten times as great as they are now.

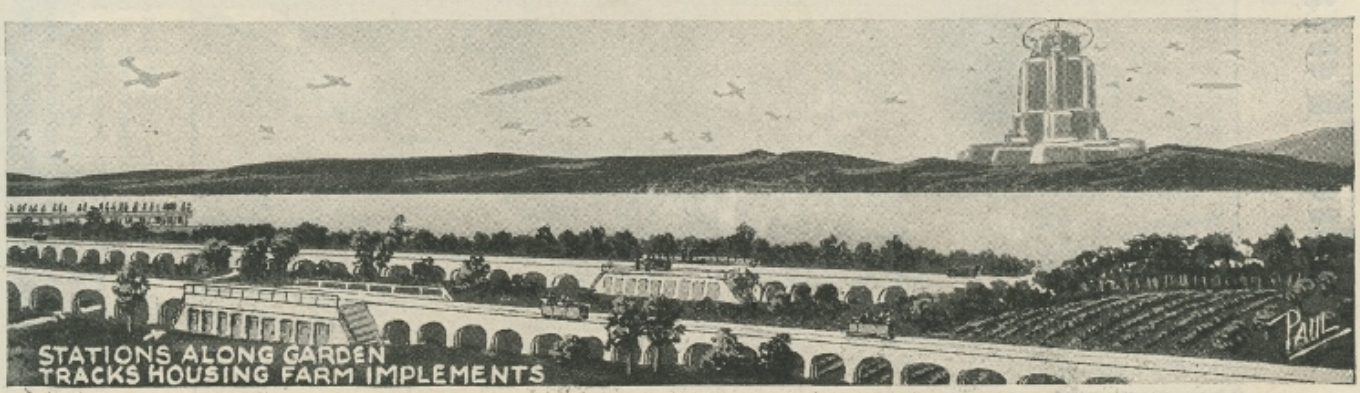
Even today, we have commuters who think nothing of traveling from 50 to 75 miles, twice a day. Only a short hundred years ago, it would have taken three days to accomplish such a trip. One hundred years hence, 500 miles and more will be the everyday occurrence, because it will take no longer to cover such distances than the fifteen-mile journey of today. That much of such travel will be done by air, is a foregone conclusion. I do not believe that the *airship* (that is the lighter-than-air type) will prevail in the future. Rather, we will have fast traveling aerial machines of a type that may not be even imagined today. Such machines will fly at the rate of 200 to 400 miles an hour, depending on the distances; for shorter distances, lower speeds will prevail, because of the resistance of the air. For longer distances we will have machines that travel in the stratosphere; and it will be as easy to travel 1,000 miles an hour via stratosphere, as 200 miles an hour through the lower atmosphere.

A hundred years hence, business will have adapted itself to many new conditions unthought of today. We are already heading in this direction, since certain business activities are all converged upon a small area. For instance in New York, the entire manufacturing fur center is grouped within a few blocks. So is the silk industry, and the same is true of others. This concentration will go on even more as time goes on, and by the year 2032, we will have huge "unit buildings" that house everything in any one industry. Huge 100-story buildings will house the entire electrical industry, for instance; another building will house the clothing industry; another the radio industry, and so on. Of course, there will still be small stores, but these also will be located near the parent industry; because it will be easier not only for the customers, but for the dealers as well, to be as near the parent building as feasible.

Everything will be "zoned" to the *N*th degree. This will be important, because the all-important factor, time, will be so pressing that people simply must stay in small areas to avoid congested transportation. It is much easier for an out-of-town jobber to stay in a single building block and transact all of his business there, rather than roam all over town. But of course this is the ideal condition. Suppose you own a department store, somewhere out west. Naturally, you will have to visit more than one unit block, because you will be interested in a variety of merchandise. This must mean traveling about town, but it will be made easier for the buyer 100 years hence than now. Already one of our electrical manufacturing companies has proposed a system termed the "Biway." * The Biway is to be erected at a higher level than the present elevated systems, and it will run right through existing buildings, connecting different units all over town. These Biways, which have been predicted for many years, and which will come about eventually, will become more important as the population of the large cities increases. The Biway is really a number of moving platforms of varying speeds, where you step from one to another of a higher speed until you get to the final platform, moving at the rate of say 25 to 50 miles per hour. Here you take a seat and, when you come near

(*Continued on page* 974)

* See August Issue, this magazine.



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Monstrous Machines of the Next War

See Page 536

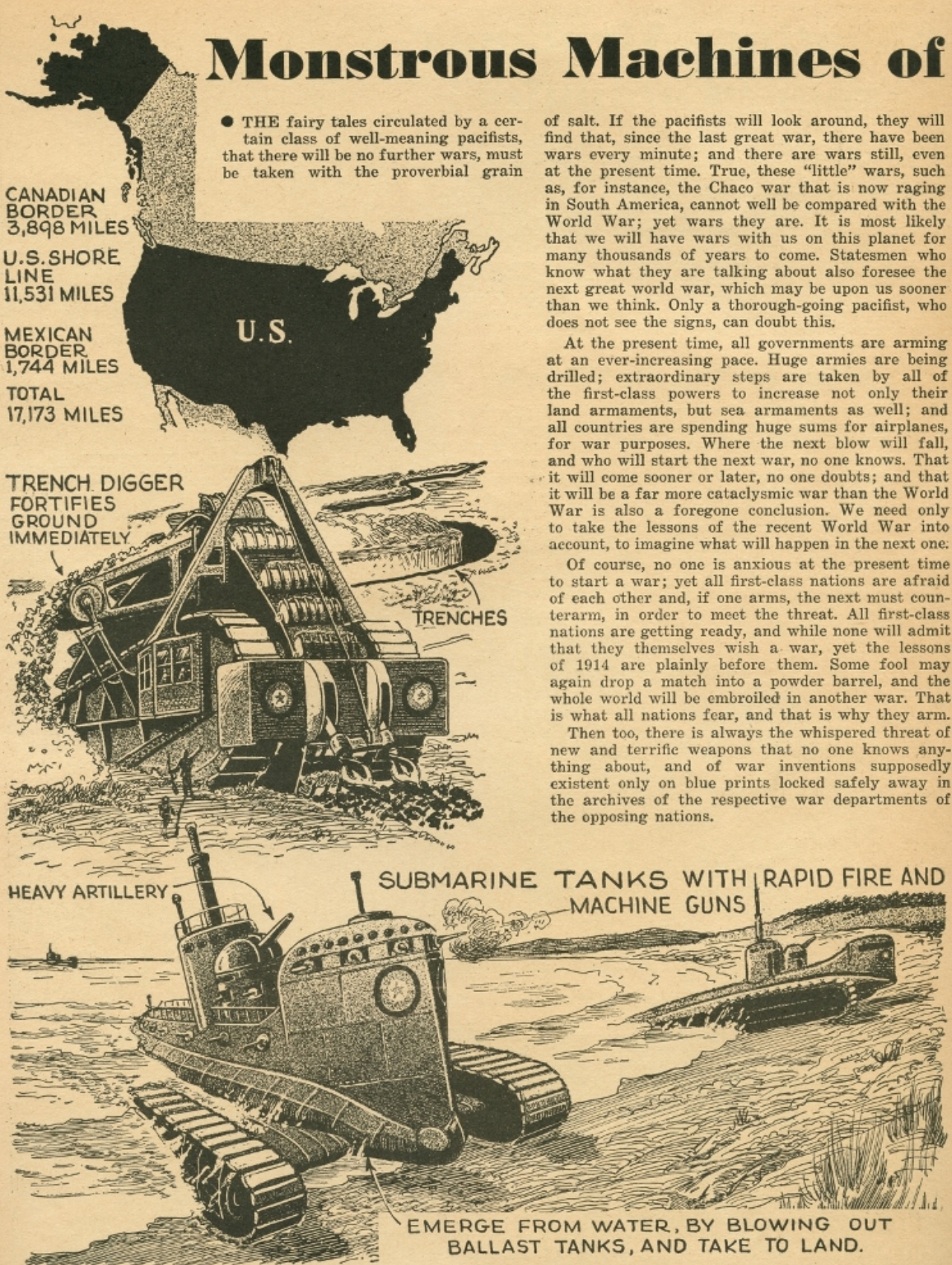
Monstrous Machines of

● THE fairy tales circulated by a certain class of well-meaning pacifists, that there will be no further wars, must be taken with the proverbial grain of salt. If the pacifists will look around, they will find that, since the last great war, there have been wars every minute; and there are wars still, even at the present time. True, these "little" wars, such as, for instance, the Chaco war that is now raging in South America, cannot well be compared with the World War; yet wars they are. It is most likely that we will have wars with us on this planet for many thousands of years to come. Statesmen who know what they are talking about also foresee the next great world war, which may be upon us sooner than we think. Only a thorough-going pacifist, who does not see the signs, can doubt this.

At the present time, all governments are arming at an ever-increasing pace. Huge armies are being drilled; extraordinary steps are taken by all of the first-class powers to increase not only their land armaments, but sea armaments as well; and all countries are spending huge sums for airplanes, for war purposes. Where the next blow will fall, and who will start the next war, no one knows. That it will come sooner or later, no one doubts; and that it will be a far more cataclysmic war than the World War is also a foregone conclusion. We need only to take the lessons of the recent World War into account, to imagine what will happen in the next one.

Of course, no one is anxious at the present time to start a war; yet all first-class nations are afraid of each other and, if one arms, the next must counterarm, in order to meet the threat. All first-class nations are getting ready, and while none will admit that they themselves wish a war, yet the lessons of 1914 are plainly before them. Some fool may again drop a match into a powder barrel, and the whole world will be embroiled in another war. That is what all nations fear, and that is why they arm.

Then too, there is always the whispered threat of new and terrific weapons that no one knows anything about, and of war inventions supposedly existent only on blue prints locked safely away in the archives of the respective war departments of the opposing nations.



Top, outline map of the United States, showing its tremendous length of frontier, at present undefended except for a few coast fortifications near large seaports. Middle, a fortifying machine, which is an enlargement of modern excavating machinery, with special adaptations for the construction and reenforcing of field earthworks. Bottom, a new type of proposed coast defense craft, for service both on land and in the water, as required.

the Next War

By HUGO GERNSBACK

We hear constantly about new and terrible gases, far more deadly than those used during the World War. We hear of "death rays," and of many other equally deadly weapons. What they will be, no one knows accurately; but that there may be some truth in the rumors, no one will deny. Coming nearer home, we find that the United States, possibly the richest country in the world today, is the least protected. Suppose there were to be a World War, with all the other nations against the United States, tomorrow. Our preparations, it is universally admitted, are woefully inadequate. Our navy is already being outclassed with better and more modern ships by several other nations. Our standing army of 132,000 men compares poorly with the standing armies of the following nations:

Russia	848,000
France	607,000
Italy	457,200
British Empire	403,000
Poland	332,100
Roumania	244,800
Japan	225,000
Jugo Slavia	139,000
Czechoslovakia	138,000
Turkey	133,000
Germany	100,000 (?)

In aviation, too, we are far behind, and certainly could not hope to defend ourselves if we were attacked on two or

(Continued on page 564)

Top, a lightning thrower, utilizing the principle of high-voltage discharges, as in apparatus shown on other pages. Millions of volts charge is concentrated on the projecting arm, which can be aimed. Below, the proposed revolutionary land battleship, which is a traveling fort, armed with the heaviest of long-range guns; and which is accompanied by airplanes, for which it has all accommodations.

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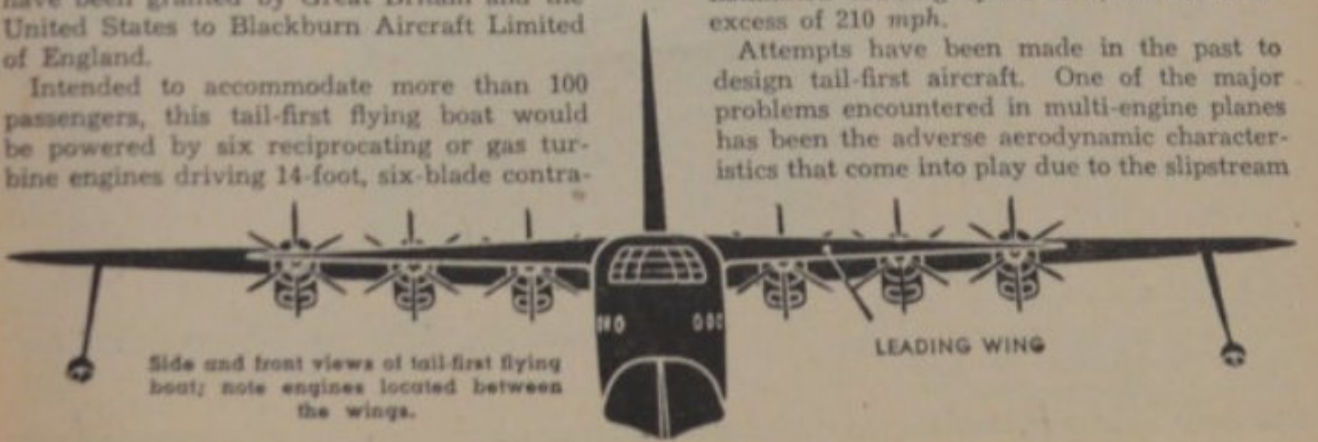
Visualization of the unusual tandem wing flying boat (in flight) designed by Thomas Cochrane Campbell and Vincent Hall for Blackburn Aircraft Ltd.

Tomorrow's Plane Sprouts Extra Wing

OUT of a welter of designs for the super-air transports of tomorrow comes one that is arousing considerable interest in British and American aviation circles because of its unusual wing arrangement. This aircraft is a flying boat with two wings, a small one located ahead of the usual large wing. Patents on it have been granted by Great Britain and the United States to Blackburn Aircraft Limited of England.

Intended to accommodate more than 100 passengers, this tail-first flying boat would be powered by six reciprocating or gas turbine engines driving 14-foot, six-blade contra-rotating propellers. The engines would be placed on the leading edge of the big main wing, thus between the small and large wings. Estimated cruising speed at 5,000 feet is in excess of 210 *mph*.

Attempts have been made in the past to design tail-first aircraft. One of the major problems encountered in multi-engine planes has been the adverse aerodynamic characteristics that come into play due to the slipstream



Side and front views of tail-first flying boat; note engines located between the wings.